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September 1952

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The American Journal of Surgery is published monthly, by The American Journal of Surgery, Inc., 49 West 45th Street, New York 19, N. Y. Yearly Subscription, $12.00 U. S. A.; $14.00 Canada and Pan-American Countries; $15.00 Foreign. Single Numbers $2.00; Special Numbers $4.00. Reentered as second class matter February 7, 1951, at the Post Office, New York, N. Y. and on February 7, 1951, at York, Pa., under the act of March 3, 1879. September 1952—New Series, Volume LXXXIV, No. 3. *Copyright, 1952, by The American Journal of Surgery, Inc.*

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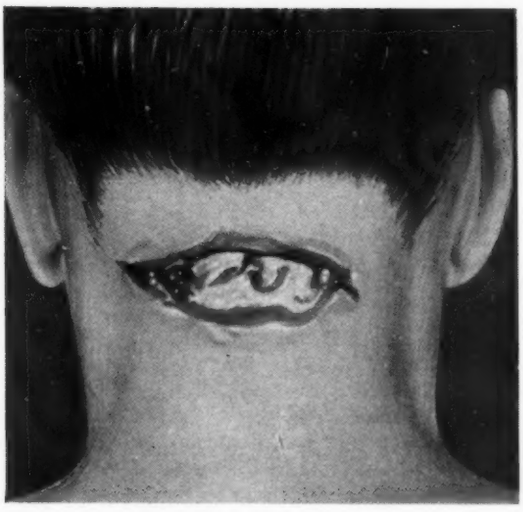

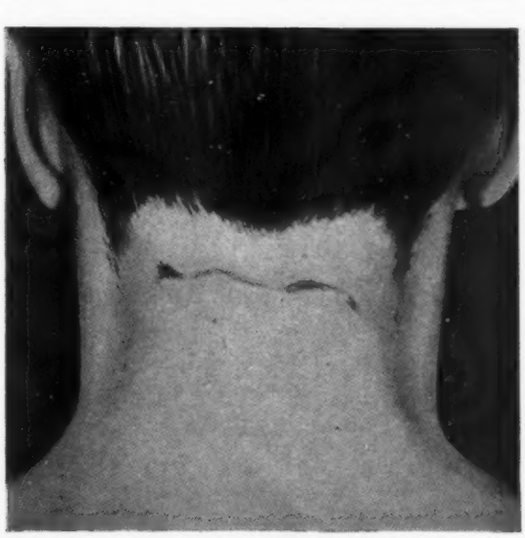

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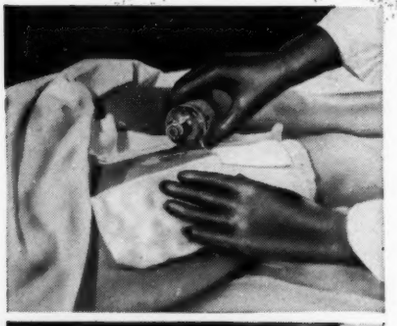

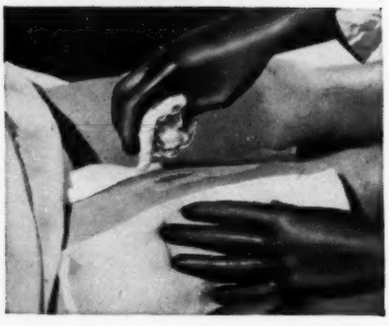

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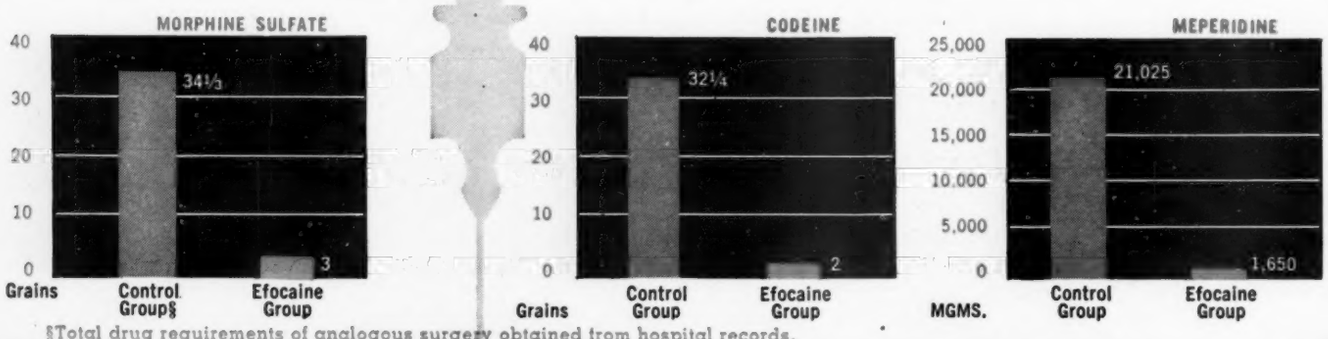

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LITERATURE ON REQUEST

‡Iason, A. H., and Shaftel, H. E.: A New Approach to the Problem of Postoperative Pain, Am. J. Surg. 83, (April) 1952.

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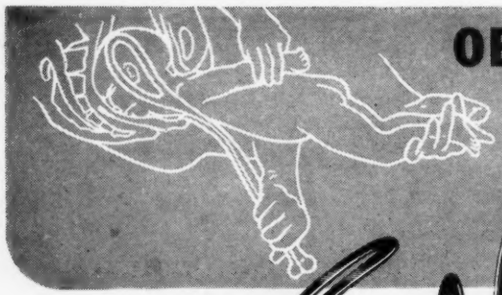

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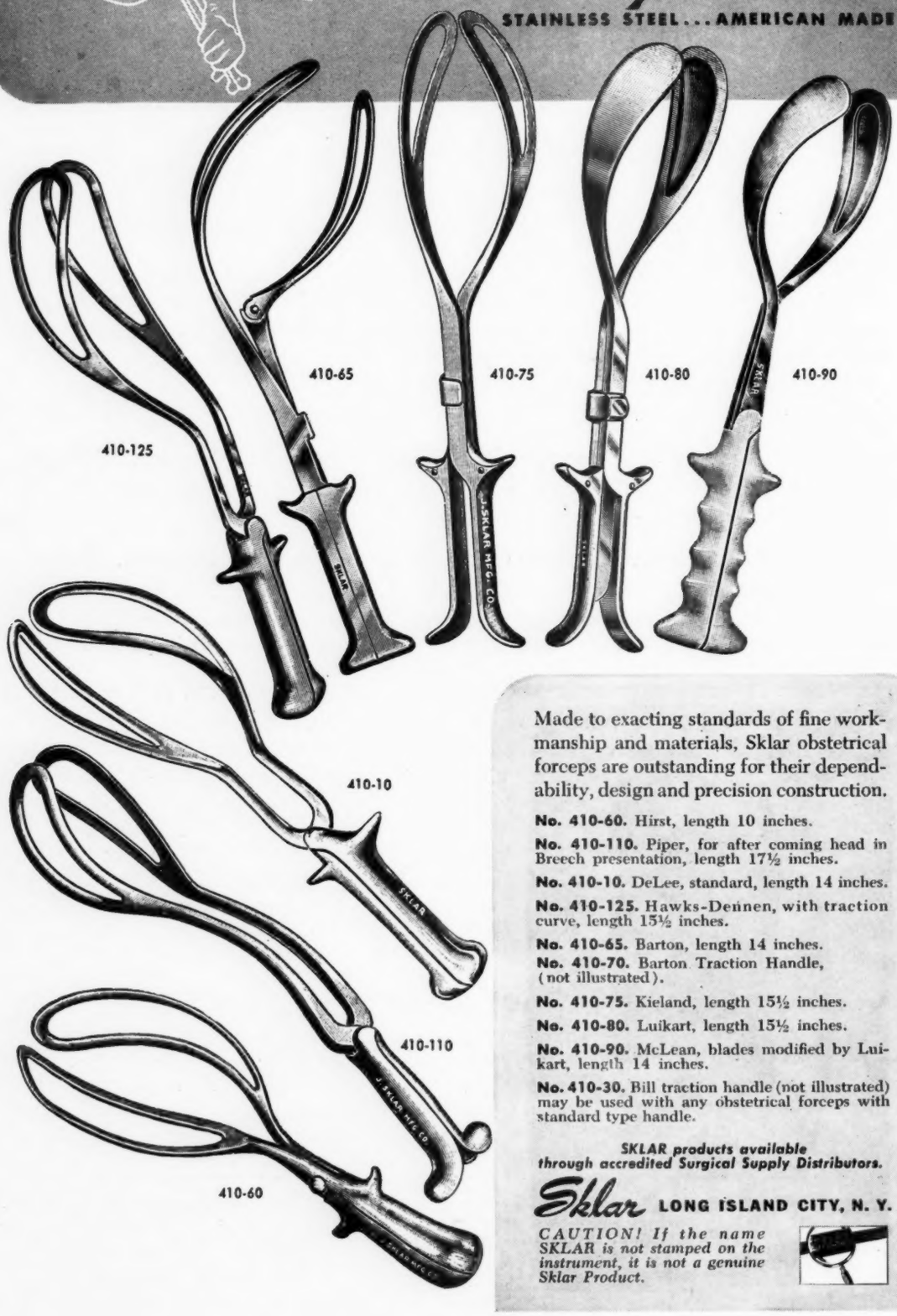

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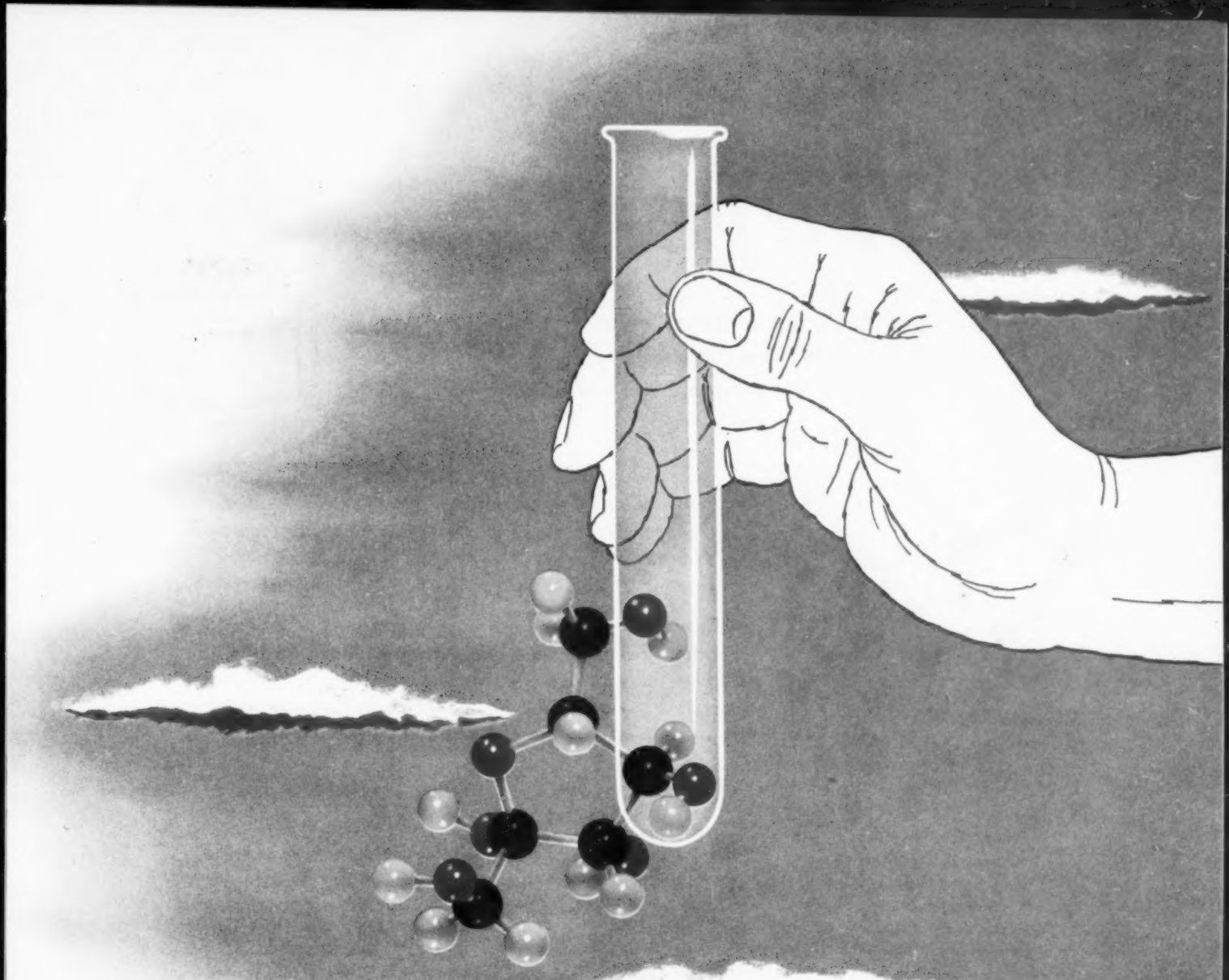

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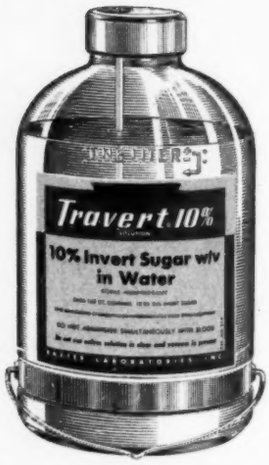

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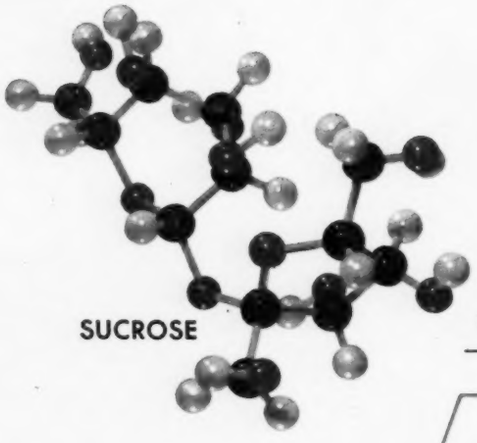

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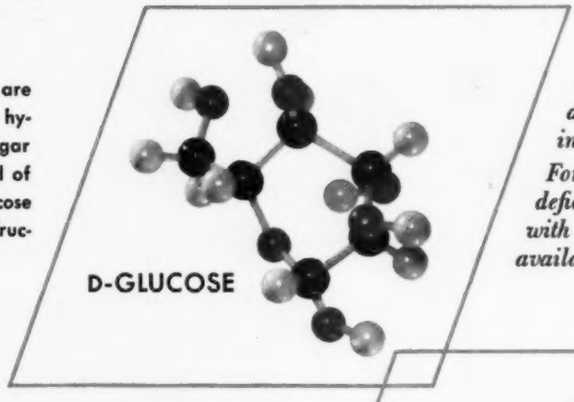

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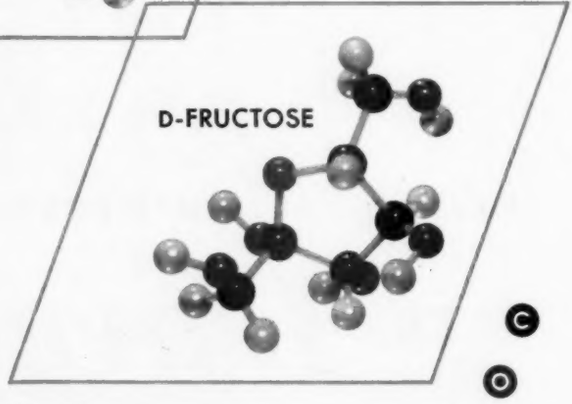

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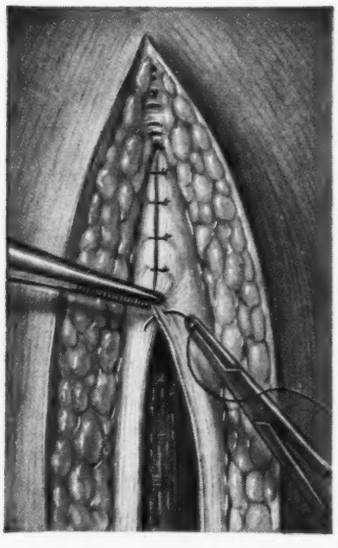

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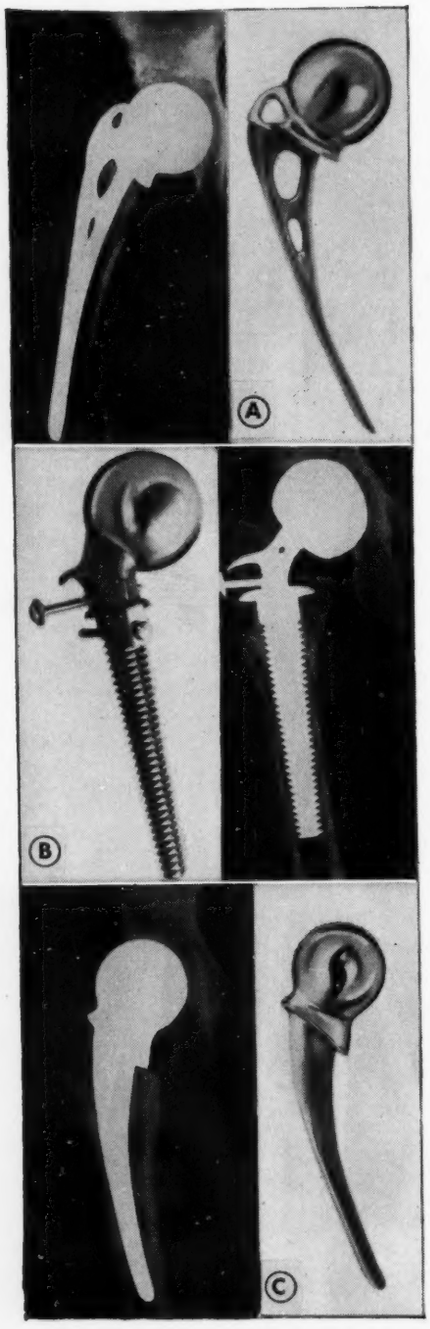

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A rigid, well-balanced intramedullary prosthesis, with broad distribution of weight bearing stresses. It is assembled in the patient's femur during operation. The head portion is free to rotate on the pivot rod. Muscle pull and weight bearing prevent dislocation of the head. Two head styles are available in the same diameter. One provides a shorter head-neck length.

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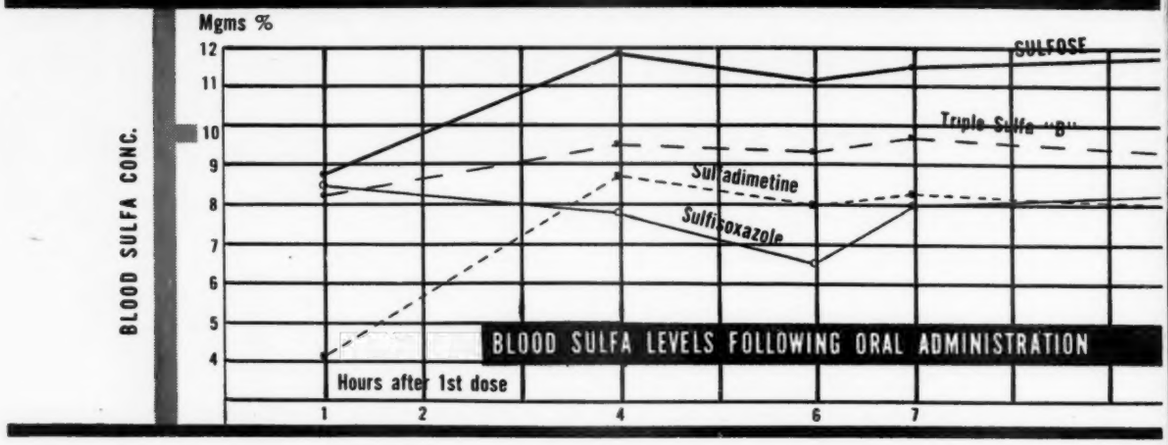


1. *SULFOSE is more effective*

—higher, more prolonged blood levels than any other sulfa preparation studied—single or combination[1]

—excellent tissue distribution—spinal fluid levels superior to those produced by single sulfonamides

—superior antibacterial potency, because of potentiating action of sulfonamide mixture

2. *SULFOSE is better tolerated*

—higher solubility in *acid urine* than single sulfonamides (with acetyl derivatives), minimizes danger of renal blockage

—minimal tissue toxicity; blood cell damage, nausea, vomiting, etc., occur less frequently than with single sulfa therapy

3. *SULFOSE is a triple sulfa*

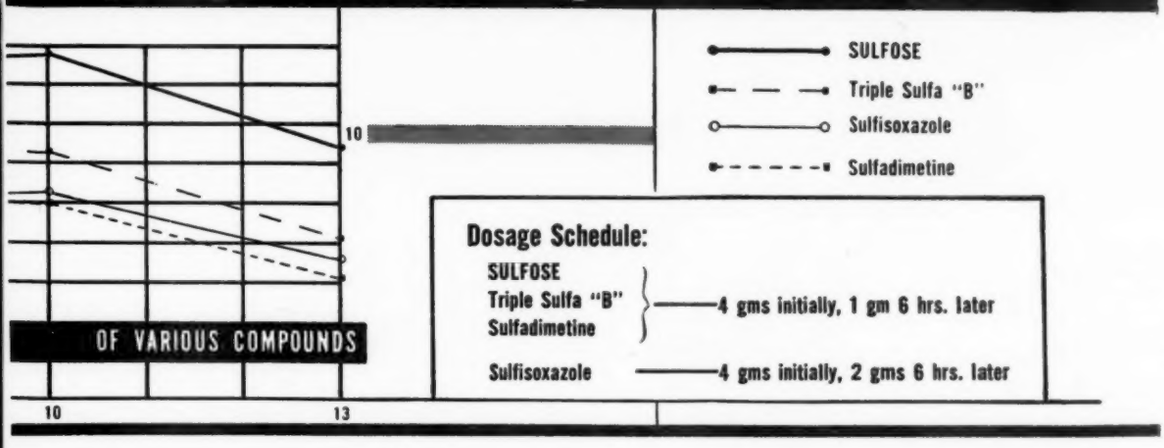
—danger of sensitization is minimal because each sulfa component is given in low dosage. Sensitization becomes more frequent when daily doses of a sulfa drug exceed 4 Gm.[2]

4. *SULFOSE is more convenient*

—low daily dosage requirement (4 Gm. for adults) means minimal interference with rest

—alkali adjuvant less likely to be needed than with single sulfa therapy

preparation equals Sulfose



5. *SULFOSE is more economical*

—costs less per dose than modern single sulfas; also, fewer doses are needed

6. *SULFOSE is palatable*

—insures acceptability to patient

For all infections amenable to systemic sulfa therapy. Suspension SULFOSE contains sulfadiazine, sulfamerazine and sulfamethazine in a special alumina gel base.

Suspension

SULFOSE®

Triple Sulfonamides Wyeth

Supplied: Bottles of 1 pint.
Also available: Tablets SULFOSE, 0.5 Gm.: bottles of 100.

1. Berkowitz, D.: To be published.
2. Lehr D.: New York State J. Med. *50*:361 (June 1) 1950.

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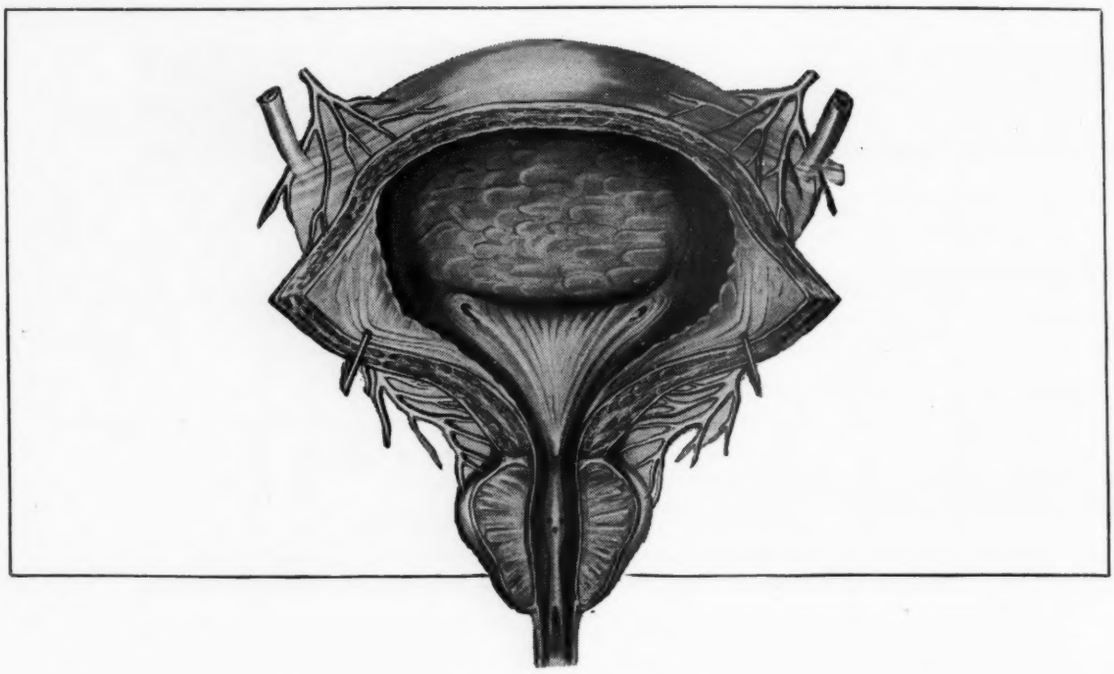

Retention Relieved Pharmacodynamically

URECHOLINE® is highly effective in the prevention and control of bladder dysfunction including postoperative urinary retention. It increases muscular tone of the bladder and produces a contraction sufficiently strong to initiate micturition and empty the bladder. Encouraging results also have been reported following the use of URECHOLINE in gastric retention, abdominal distention, and megacolon.

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more rapid relief of pain WITH THE **motorized intermittent tractolator***

WHEN CERVICAL TRACTION IS INDICATED

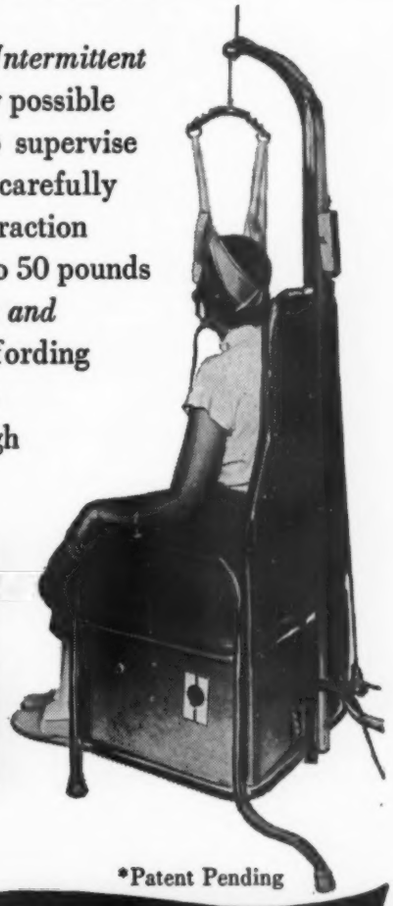
"Some patients who had previously received 5 to 8 pounds of constant traction without relief obtained rapid relief when 25 to 50 pounds of force were applied . . . Constant inadequate traction will not provide relief of pain; whereas adequate traction, even though applied intermittently, will often provide relief."

Intermittent Traction for Herniated Discs—by Bernard Judovich, M.D., Golda R. Nobel, M.D. Medical Times, Jan. 1952; Pain Syndromes—Bernard Judovich, William Bates. F. A. Davis Co., Philadelphia, 4th edition (in press) 1952.

Pain in the Shoulder, Neck, and Arm;
Brachial Plexus pain due to:

- **Herniated Cervical Disc**
- **Osteoarthritis of the Cervical Spine**
- **Narrowed Intervertebral Foramen**
- **Other Conditions in Which Cervical Traction is Indicated**

With the *Motorized Intermittent Tractolator*, it is now possible for the physician to supervise administration of a carefully graduated, smooth traction force with pulls up to 50 pounds *. . . safely, precisely and automatically* . . . affording relief of pain often unobtainable through other techniques.



Suitable for Hospital or Office Therapy

- *Comfortable*
- *Sturdy*
- *Automatic*

The *Motorized Intermittent Tractolator* is now in daily use in physicians' offices and hospitals. It is a dignified, handsome addition to your professional equipment, designed in consultation with the medical profession. Duration and amount of pull are automatic, once set for treatment. The apparatus is easily adjusted to the individual patient. Complete, simple instructions are provided with each Tractolator.

The *Motorized Intermittent Tractolator* is also available as a bed apparatus for cervical and lumbar traction. Details on request.

*Patent Pending

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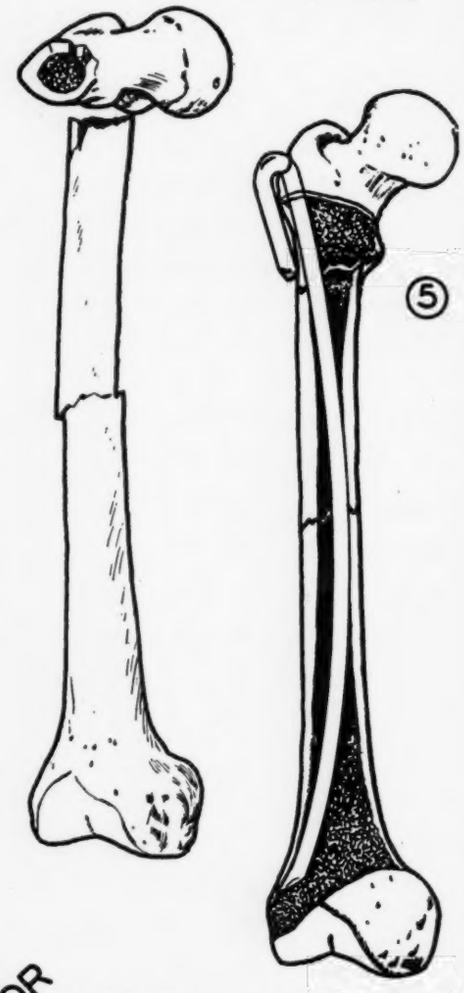
SPECIAL FEMUR PIN



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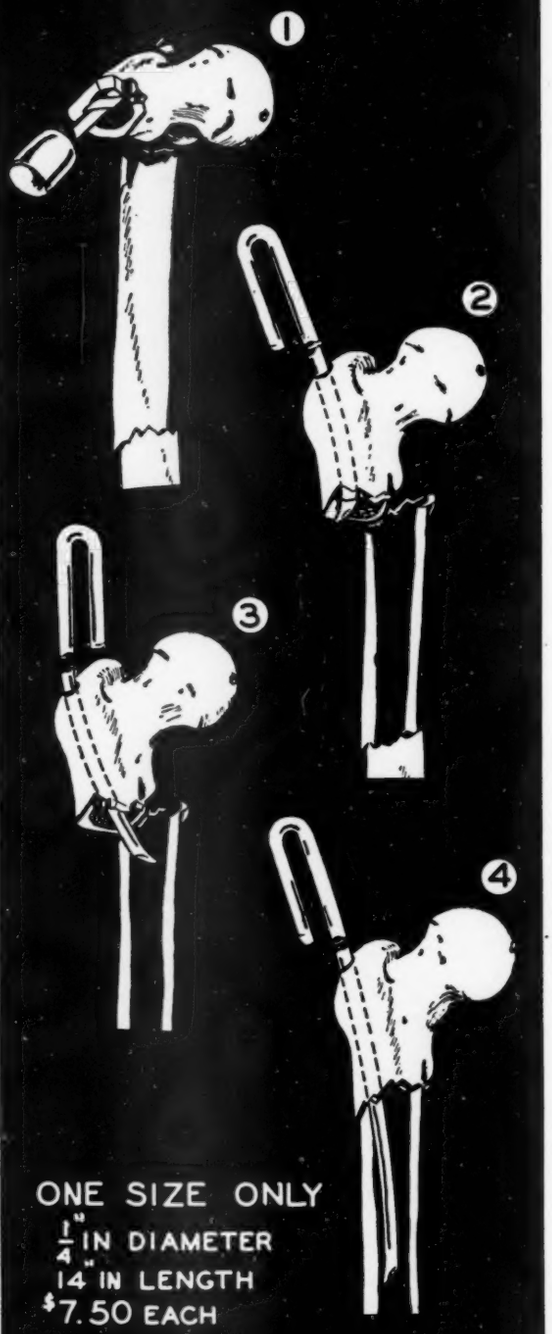

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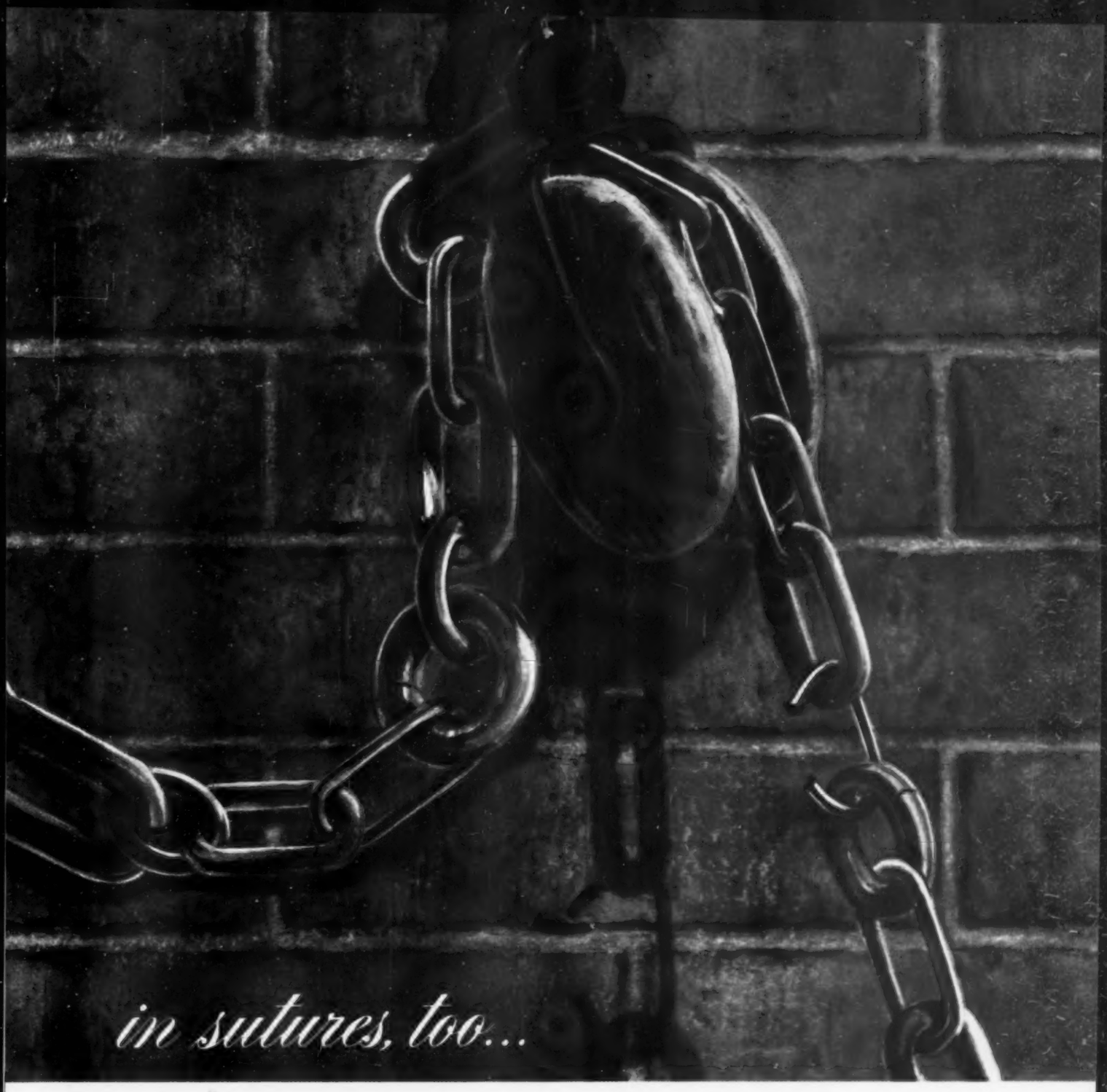

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Ethicon's exclusive Tru-Gauging process provides remarkable uniformity of gauge and strength. *All* Ethicon Surgical Gut testing standards are far above U.S.P. minimum tensile strength requirements, permitting the use of smaller strands without sacrifice of suture strength.

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SUTURE LABORATORIES AT NEW BRUNSWICK, N. J.; CHICAGO, ILL.; SAO PAULO, BRAZIL; SYDNEY, AUSTRALIA; EDINBURGH, SCOTLAND.

COMPLETE ABSORPTION AT THE PROPER TIME

ETHICON *Surgical Gut*

Tru-Chromicized

minimizes foreign body irritation after the wound is healed

Ethicon Tru-Chromicized Surgical Gut provides a safe margin of suture-holding strength during wound healing—but digests soon after the suture is no longer needed.

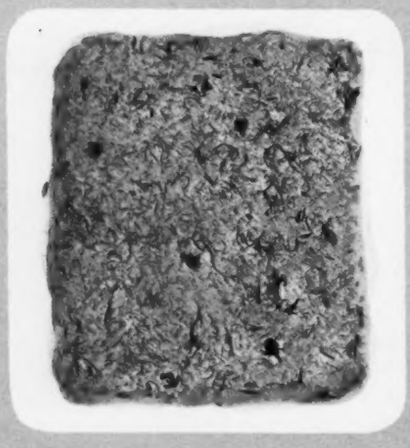
How Tru-Chromicizing Provides Safety and Reduces Irritation—In Ethicon's exclusive Tru-Chromicizing process, the individual ribbons of raw gut are chromicized *before* they are spun and dried. The chrome is evenly distributed and each portion of the strand, throughout the cross-section, has the same chrome content and enzyme resistance.

This more uniform chrome distribution not only assures maintenance of tensile strength throughout the normal healing cycle, but also provides an adequate safety margin for delayed healing. When the need for support has passed, *complete* digestion of the suture takes place.

Tru-Chromicizing permits the use of smaller sutures because Ethicon small sizes retain their holding power almost as long as larger sizes.

YOU COULD MAKE THIS SIMPLE TEST

Loops of gut were tied around a glass tube and immersed in 1% trypsin solution. After 200 hours (comparable to 6 months in tissue) the residue was spread on glass plates. Note the difference.



1. Ordinary surface chromicizing shows residue of undigested knots and suture fragments.

2. Tru-Chromicizing permits complete absorption, no undigested residue.

Corticotropin (ACTH)

Upjohn

The Upjohn Company in early June announced production of Cortisone Acetate, 25 mg. Tablets.

Now we are announcing the availability of Corticotropin (ACTH).

Sterile Corticotropin (Upjohn) is available in two potencies: in vials containing 25 U.S.P. units and in vials containing 40 U.S.P. units.

Upjohn's extensive experience in the research and manufacture of adrenal cortical products has made it possible to provide the medical profession with *both* Cortisone and Corticotropin.

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A contribution of **Upjohn Research** *to this era of metabolic medicine*

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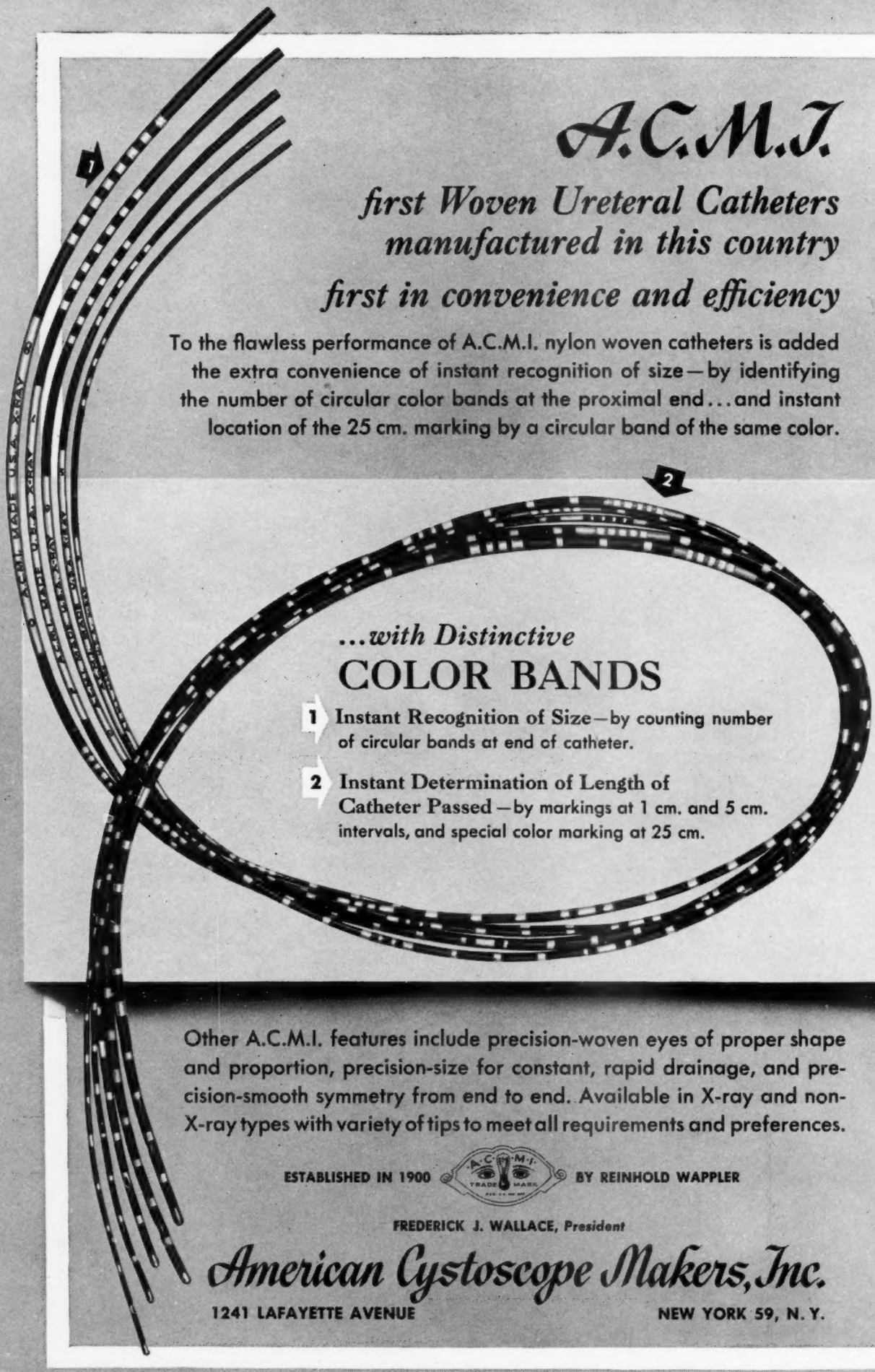
first Woven Ureteral Catheters manufactured in this country

first in convenience and efficiency

To the flawless performance of A.C.M.I. nylon woven catheters is added the extra convenience of instant recognition of size—by identifying the number of circular color bands at the proximal end...and instant location of the 25 cm. marking by a circular band of the same color.


1
2
...with Distinctive
COLOR BANDS
1 Instant Recognition of Size—by counting number of circular bands at end of catheter.
2 Instant Determination of Length of Catheter Passed—by markings at 1 cm. and 5 cm. intervals, and special color marking at 25 cm.

Other A.C.M.I. features include precision-woven eyes of proper shape and proportion, precision-size for constant, rapid drainage, and precision-smooth symmetry from end to end. Available in X-ray and non-X-ray types with variety of tips to meet all requirements and preferences.

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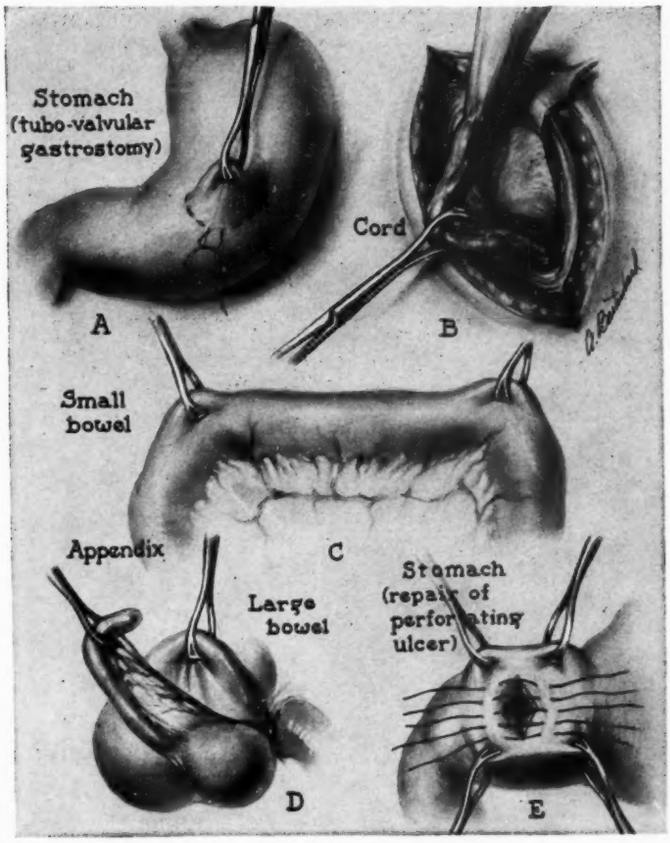

IMPROVED ANASTOMOSIS CLAMPS

The oblique, aseptic, end-to-end ileac anastomosis has become a procedure of choice in the management of small intestinal obstruction complicated by the presence of non viable bowel, either from strangulation or other cause. Laboratory study indicates this anastomosis is highly reliable, either in the presence or absence of obstruction. Dennis clamps for this anastomosis have short (5.6 cm.) jaws with less springiness to crush the tissue at the tips than others; therefore they may be more easily removed during the anastomosis. The narrow jaws taper gradually to a 4 mm. thickness at the base, have deep, sharp, matching longitudinal grooves. The clamps are 20.8 cm. in length, have the box lock, stainless steel. (Procedure is illustrated in detail in ARMAMENTARIUM Number Five, sent free on request.) Each, $17.50. Set of two, $35.00

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A forceps of unusual flexibility, this improved instrument is sufficiently strong and secure in its application to prevent the tissues held in its grasp from being easily dislodged. However, even when applied to very delicate structures, the forceps has little tendency to crush or tear: four ratchets in its locking device allow a wide choice in the amount of force the surgeon can apply. The approximating jaws are about 1 cm. wide, have no sharp corners. Curved shanks permit encirclement of certain structures without crushing or constriction. The forceps is 6 inches long, nicely made, with box lock. Stainless. Each, $9.75

Clarence Dennis
M.D.

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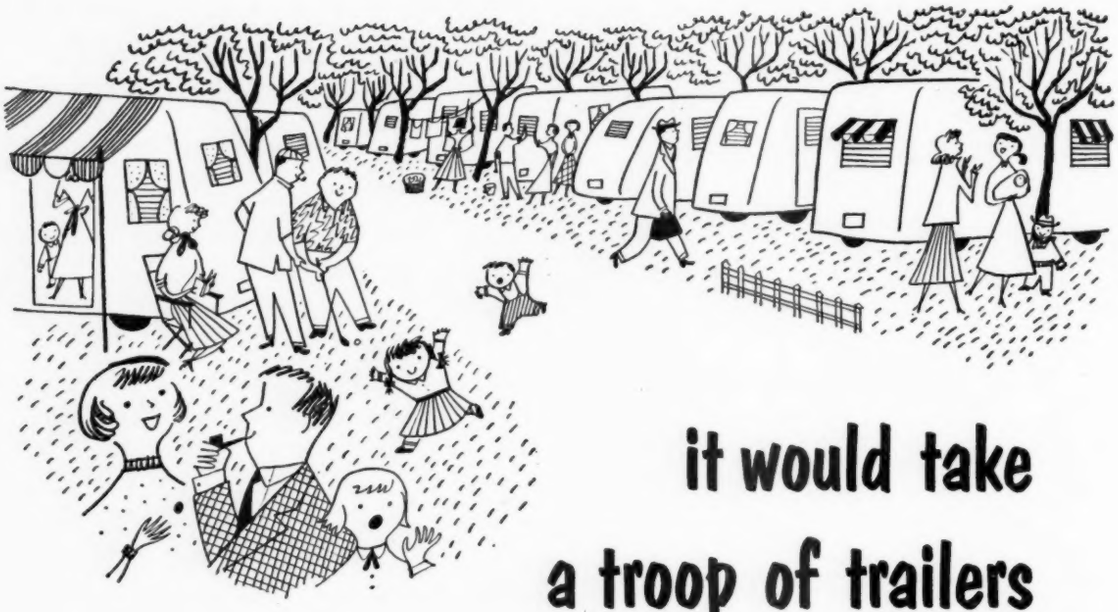

it would take a troop of trailers

. . . To house all of the patients who represent each of the many conditions for which short-acting* NEMBUTAL *is effective.

YOU'D COUNT AT LEAST 44 PEOPLE, if you could see them all at once. For over 44 uses is the clinical record for short-acting NEMBUTAL since it was introduced in 1930.

Case after case from the 570 published reports shows that adjusted doses of short-acting NEMBUTAL can achieve any desired degree of cerebral depression—from mild sedation to deep hypnosis. *And this is accomplished with only about half the dosage required by many other barbiturates.*

The dosage is small, the margin of safety is wide. Note, too, the shorter duration of effect, the virtual freedom from cumulative effect and "hangover," the definite economy for your patient.

For your copy of the new booklet, "*44 Clinical Uses for* NEMBUTAL," write Abbott Laboratories, North Chicago, Ill. Perhaps it will suggest to you additional effective uses for short-acting NEMBUTAL in your practice. Abbott

Remember:
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(PENTOBARBITAL, ABBOTT)

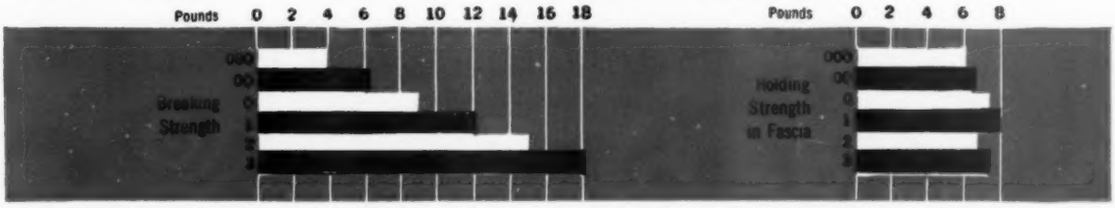
FOR INSOMNIA AND SIMPLE SEDATION
try the 50-mg. (¾-gr.)
NEMBUTAL Sodium Capsule

Smaller sizes of **D & G surgical gut** hold the uterine artery <u>longer</u> than larger sizes

Surgeons now recognize that smaller sizes of surgical gut maintain their integrity in a wound longer than larger sizes, because smaller amounts of foreign protein provoke less tissue reaction and less absorption.

Waters[1] showed that in postpartum perineal repairs, 0000 chromic gut lost only 5 ounces of its tensile strength from the third to the seventh day. He found faster healing and less pain.

Comparison of breaking strength and holding strength in fascia of various sizes of surgical gut



The strength of a sutured wound is no greater than the holding power of the tissues. Burke[2] showed that fascia will tear before 00 surgical gut breaks in it. D & G chromic 0 breaking strength on a knot pull is over 8 lbs., while the holding power of fascia is less than 8 lbs. Surgeons should use the smallest size suture which exceeds the holding power of the tissue.

Only D & G offers "timed-absorption" surgical gut

D & G surgical gut sutures are chrome-tanned to prevent premature digestion and keep the wound firmly united during the critical first days. Digestion is speeded as the wound heals. Finally there is complete absorption of the suture.

This is "timed-absorption"—unique with D & G surgical gut. For a free copy of the D & G booklet, "The Advantages of Smaller Sizes of Sutures," a review of the literature on this important surgical concept, write to:

References:

1. Waters, E. G.: Fine Chromic Catgut in Surgery and Obstetrics, Bull. Margaret Hague Mat. Hosp. 1(4): 102 (Dec.) 1948.
2. Burke, J.: A Consideration of the Suture Problem, American Journal of Surgery, 49:303, 1940.

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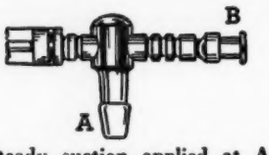
The DEVINE TUBE

. . . for decompression in intestinal obstruction

This new double-lumen, air-vent tube overcomes the problem of vacuum mucosal obstruction[1] and permits rapid, constant drainage—as much as 6000 cc. within 24 hours.[2]

It may also be used as a vacuum-free, intralumen sump tube by switching the suction to the air-vent (B). *Price, $9.75 each.**

A modification of this model, without the mercury-weighted tip, is also available for rapid and complete evacuation of stomach contents.[3] *Price upon application.*



Steady suction applied at A draws accumulated liquid and gas into the outer tube and simultaneously sucks atmospheric air into the inner (polyethylene) tube through the minute opening in B.

The small, continuous intake of air prevents the creation of a vacuum and thus prevents collapsing of the intestine around the tube and the resultant obstruction of the drainage holes by in-drawn mucosa.

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The sturdy little *Pilling Gastric Suction Pump*. Will evacuate 3000 cc. of air per minute on house current. Can be run continuously for days and won't burn out. AC only. *$59.00 each.**

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1. Devine, J. W., and others: Virginia M. Monthly 79:17 (Jan.) 1952
2. Devine, J. W., Jr.: J.A.M.A. 148:115 (Jan. 12) 1952
3. Devine, J. W., Jr., and Morrison, R. L.: Am. J. Surg. 83:396 (Mar.) 1952

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- **minimal damage to skin edges**
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- **easy removal without cutting permits repeated use**
- **precision-made of inert 18% nickel silver**
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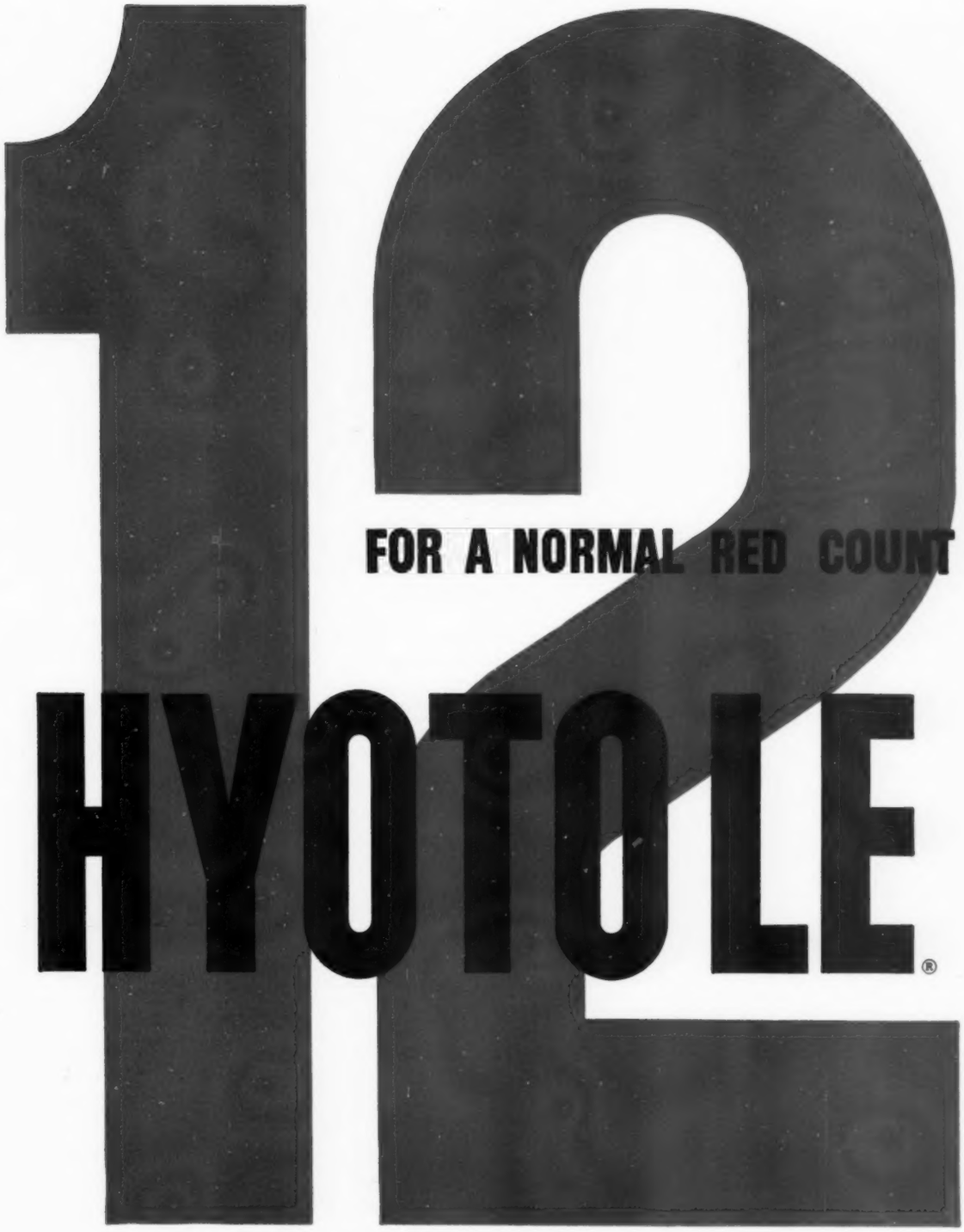

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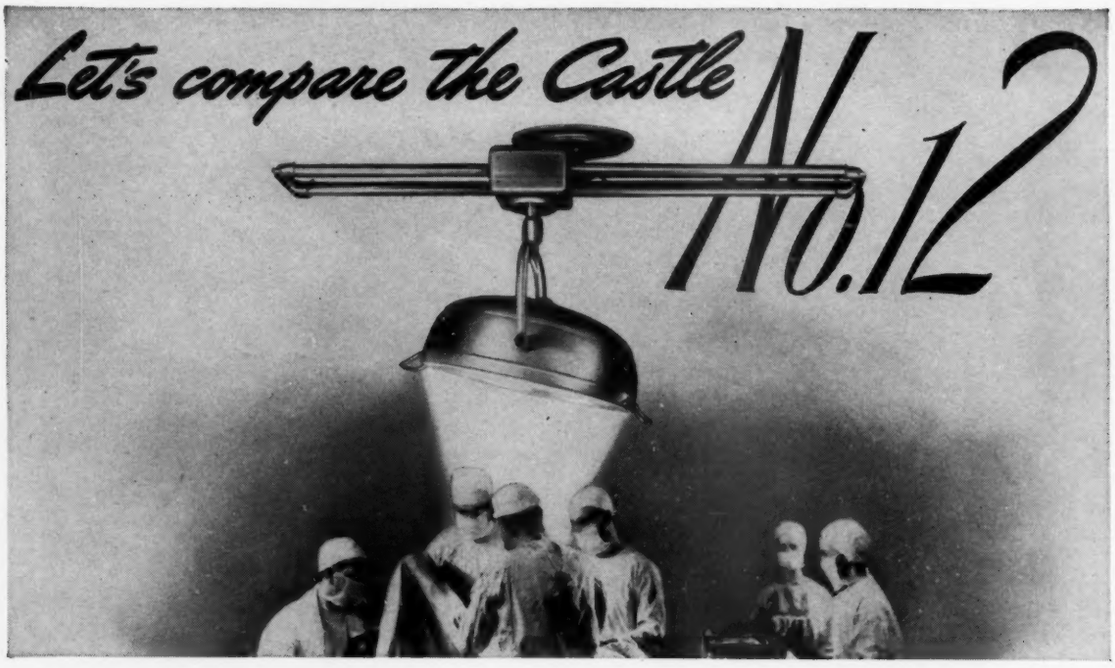

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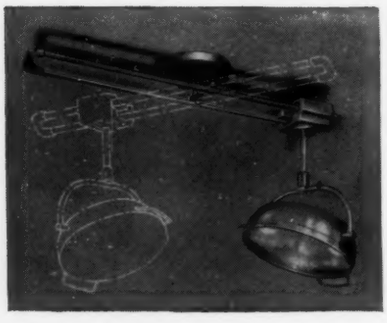

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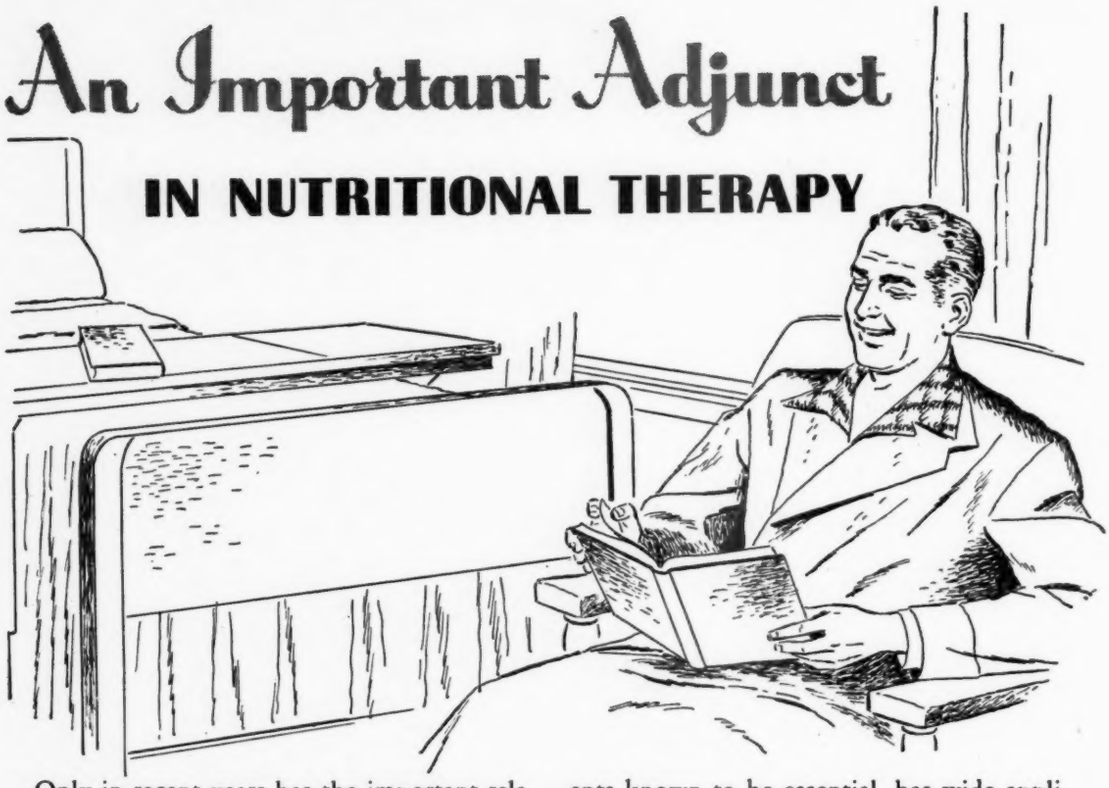

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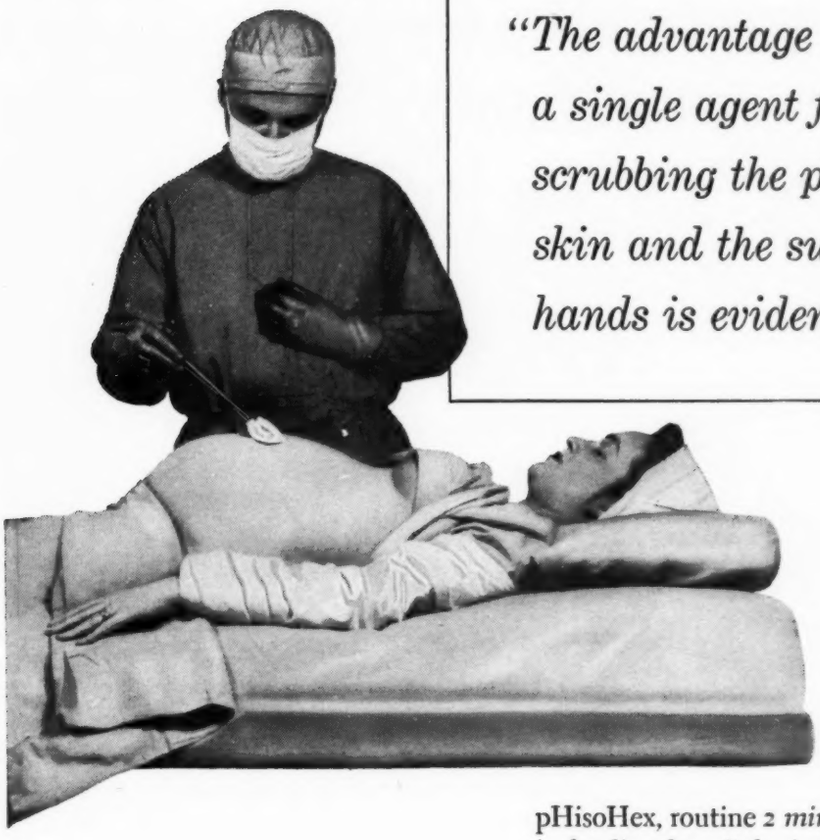
*Nutrients for which daily dietary allowances are recommended by the National Research Council.



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1. Artz, C. P., Pulaski, E. J., and Shaeffer, J. R.: *U. S. Armed Forces Med. Jour.*, 2: 819, May, 1951.

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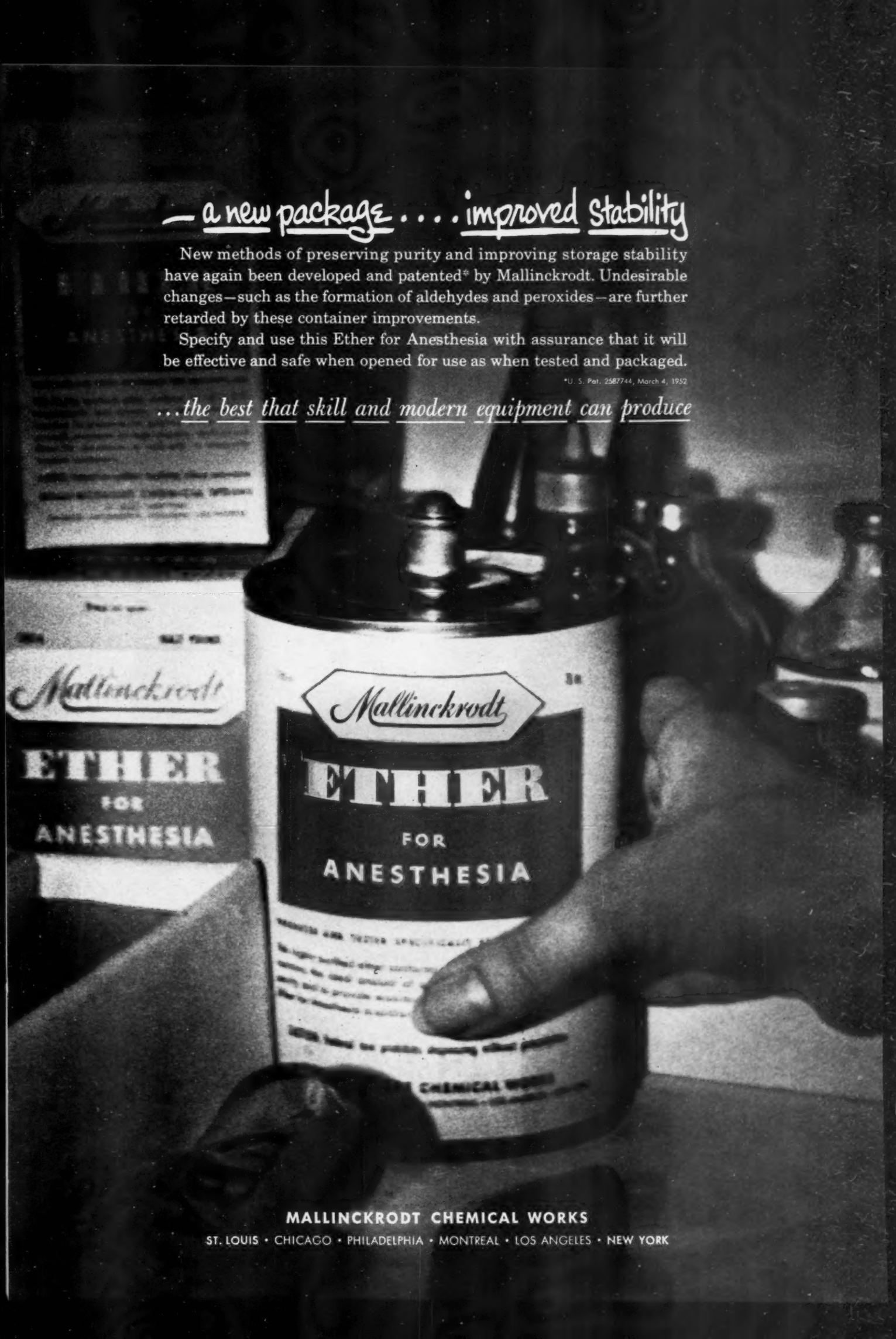
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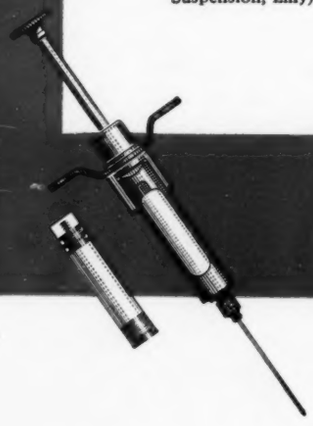

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Sixty-first Year of Publication

VOL. LXXXIV SEPTEMBER, 1952 NUMBER THREE

Editorial

TREATMENT OF SOFT PART TUMORS

THE existence of painless swellings of the soft parts is frequently known to the patient long before any steps are taken to investigate them. Many may represent harmless conditions such as sebaceous cyst or lipoma. However, there is the ever present possibility that the lesion may be malignant and that early diagnosis and prompt, appropriate treatment may be essential if the life of the patient is to be saved. In the dissemination of knowledge concerning the importance of lumps and swellings much has been achieved by such organizations as the American Cancer Society, and as a result of their efforts people are seeking medical advice more frequently and earlier than ever before. The proper handling of these cases is the topic of the present discussion.

Too often the first physician who sees the patient with a painless soft part swelling is apt to dismiss him with a reassuring word, whereupon the latter gives the matter no further attention for weeks or months or until the time when pain, marked increase in size or disability practically forces him to seek further medical advice.

Sometimes the doctor recommends biopsy or actual removal of the lump. This most important step is frequently regarded as a trivial one and is undertaken in the doctor's office under local anesthesia and with little or no skilled assistance. Many times the specimen is discarded without even being submitted for microscopic examination. On the assumption that the condition is an unimportant benign tumor or some non-neoplastic swelling, the excision is often an inadequate one and the margin of normal tissue surrounding it is frequently insufficient. When the pathologist reports fibrosarcoma, synovioma, malignant neurilemoma, myosarcoma or liposarcoma, the surprised operator is in a quandary. Shall he perform an immediate wider excision, or in the case of an extremity, an amputation; or shall he employ radiation; or shall he merely keep the patient under close observation and await evidence of a local recurrence? If the last course is chosen and a recurrence does take place, the question of *what to do* is again raised.

It seems to the writer that in the general management of tumors of the soft parts the tendency is to assume at the outset that they are benign, whereas in his opinion a safer policy would be to assume that they are malignant until the pathologist has had an opportunity to examine the entire tumor after a wide excision has been performed.

If the microscopic report clearly indicates the presence of a malignant tumor which has a safe margin of normal tissue on all aspects, it may be justifiable to "sit tight" with frequent follow-up observations; however, to treat subsequent local recurrences by repeated local excisions seems illogical.

When seen for the first time a soft part tumor should always be widely excised if possible and not merely cut into for biopsy purposes. More aggressive surgical extirpation at the outset may in the long run prove to be conservative

surgery and may result in saving many limbs and lives.

If the first excision fails, it is only in the exceptional case that a second will prove successful; and with each succeeding failure the prospect of complete eradication still further decreases while the chances of distant metastasis increase. It is reasonable, then, to conclude that after failure of one well conceived and executed excision the next procedure to be considered is amputation if such is technically feasible. There are few situations in the general field of neoplastic disease in which the principle of *too little and too late* applies more forcefully.

BRADLEY L. COLEY, M.D.

Original Articles

RUPTURE OF THE INTERVERTEBRAL DISC IN INDUSTRY

FURTHER OBSERVATIONS ON THE END RESULTS

ALEXANDER P. AITKEN, M.D.

Boston, Massachusetts

IN the history of medicine there have been few problems which have been more baffling than those presented by lesions characterized by low back pain with or without radiation into the lower extremity. Our inability to solve this problem has been and still is due to our lack of understanding of the fundamental pathology involved in lesions of the low back. Strains of the low back brought on by lifting or twisting are perhaps the commonest of all injuries, yet today we have no knowledge of the exact nature or site of the lesions so produced. Such strain is variously described as occurring in the low back muscles or in the various intraspinal ligaments. Others believe that the lesion occurs in the capsules of the facets due to abnormal excursion of these structures brought on by trauma alone or superimposed on congenitally unstable joints. When such injuries become complicated by pain radiating into the lower extremity, the problem becomes even more complex. There are those who believe that such radiation is pathognomonic of a ruptured intervertebral disc. It cannot be denied that the recognition of the ruptured intervertebral disc and its symptom complex represents a definite advance in the diagnosis and treatment of lesions of the low back. However, there is considerable doubt that all lesions characterized by back and leg pain are to be explained on such a diagnosis. Since most patients give a history of trauma, this problem has become of great importance in the field of industry.

In 1947 Dr. Charles Bradford and I reported the end result study of operation for ruptured intervertebral disc performed between the years 1940 and 1947 in 170 compensation cases. To this series an additional forty-one cases were added. These cases were obtained from the files of a large compensation carrier. As long as compensation was paid, these cases could be followed. This represented a definite advantage over the individual investigator who is apt to lose contact with his patients, particularly if operation failed to bring the desired relief. A fairly accurate picture of how industrial patients suffering from back and leg pain were handled throughout the country was obtained.

The first study demonstrated that the end results as performed in compensation cases were disappointing. In 79 of the 211 cases the surgeons admitted that no disc disorder was found, representing a diagnostic error of 37 per cent. In those cases in which a protruded disc was said to have been found, the results were as follows: excellent 15 per cent; good 20 per cent; fair 38 per cent; poor 25 per cent. In the cases in which no disc disorder was found, the results were: excellent 2.5 per cent; good 11 per cent; fair 34 per cent; poor 49 per cent. Thus two to eight years after injury 25 per cent of the disc patients and 49 per cent of the no-disc group had failed to return to work. Persistence of symptoms following simple disc removal in those cases in which disc disorder was said to have been found led to reoperation in 21 per cent of the cases. Persistence of symptoms following simple exploration in those cases in which no disc disorder was found led to reoperation in 33 per cent of the cases. The results of this study indicated that the diagnostic criteria such as the total protein determination, the myelogram and the clinical findings including the roentgenograms, singly or in combination, were faulty and suggested that the poor results were largely due to failure in diagnosis and failure in proper selection of cases for surgery.

There was also ample evidence that many of the poor results were due to faulty surgical technic and to radical or inadvised surgery. Perhaps such results are to be anticipated when a relatively new surgical procedure is first adopted. With further experience improvement in diagnosis and surgical technic might be expected. We have recently completed another study of ruptured disc operations performed within the three-year period from 1947 to 1949. This study consists of 200 cases. In 104 cases surgery was performed by neurosurgeons; in forty-one cases by orthopedists; and in fifty-five cases both neurosurgeon and orthopedist participated. Twenty-eight states are represented.

TABLE 1
AGES OF PATIENTS SUBJECTED TO SURGERY

Years	No. of Patients
Under 20	3
20–30	24
30–40	77
40–50	62
50–60	27
60–70	6
70–80	1

In seventy-five patients in the disc series (45 per cent) and in thirteen patients (37 per cent) in the no-disc group there was an antecedent history of back pain.

The nature of injury in the entire series was due to lifting, pulling or pushing in 137 cases. Other causes were as follows: twisting twenty-four, falls thirty-five, direct blow one, while no history of injury was obtained in three cases.

The ages of patients subjected to operation are shown in Table 1.

In thirty-five cases no disc disorder was found, representing a diagnostic error of 17.5 per cent which compares favorably with the previous series in which the diagnostic error was 37 per cent.

As in the previous studies we have divided this series into two groups: the disc group in which disc disorder is said to have been found, and the no-disc group in which no disc disorder was found. We have classified the results as follows: Excellent, if the patient had little or no pain and was able to return to any type of employment; good, if the patient had only mild discomfort and was capable of doing all but the heaviest work; fair, if the patient had pain and could do only light work requiring little or no bending or lifting; poor, if the patient had persistent pain and failed to return to any type of work; bad, if the patient was worse than before operation and was considered to be totally and permanently disabled.

The end results of this series in 165 disc cases were as follows: excellent, forty-two (25 per cent); good, thirty-three (20 per cent); fair thirty-five (21 per cent); poor, forty-five (27 per cent); bad, ten (6 per cent).

In thirty-five no-disc cases the results were: excellent, five (14 per cent); good, four (12 per cent); fair, nine (26 per cent); poor, eleven (30 per cent); bad, six (17 per cent).

Thus two to five years after operation 33 per cent of the patients with disc disorder failed to return to work, while in the no-disc series 47 per cent failed to return to work. In the disc group forty-six cases or 28 per cent are still on compensation two to five years after surgery; 12 per cent are on partial compensation and 16 per cent on total compensation. In the no-disc group 31 per cent are still on compensation, 11 per cent on partial and 20 per cent on total.

Women injured as a result of an occupational accident appear to be poor candidates for disc surgery. Fifteen patients in this series in whom a disc disorder is said to have been found, show the following results: excellent, one (6.6 per cent); good, one (6.6 per cent); fair, one (6.6 per cent); poor, nine (60 per cent); bad, three (20 per cent). Three patients in whom no disc disorder was found gave two poor (66 per cent) and one bad result (33 per cent). Combining both series a total of thirty-eight women have been operated upon with two excellent, two good, two fair, twenty-four poor and eight bad results. Thus only six of thirty-eight women (16 per cent) ever returned to some form of gainful employment following surgery.

The statistics compiled in this series would seem to indicate that despite the greater experience gained in the ensuing years, the end results of disc surgery in industrial cases have not improved. It appears that we still have much to learn in diagnosis, technic and proper selection of cases for surgery.

A review of the more common diagnostic criteria may prove of some interest.

Distribution of Pain. In the disc group 159 patients gave a history of back and leg pain. Six patients gave a history of back pain only. In the no-disc series thirty-four patients

gave a history of back and leg pain, while one gave a history of back pain only. Most surgeons attach great significance to the presence of leg pain and many consider that its presence is of necessity due to pressure on nerve roots. The aforementioned figures in the twenty-seven cases in which the determination ranged from 40 mg. to 2,200 mg. per cent. In the no-disc series there was but one normal protein determination, while nine patients showed elevations from 40 to 150 mg. per cent. This would tend to confirm the impression

TABLE II
MYELOGRAM FINDINGS

Discs, 119 Cases					No Discs, 25 Cases		
Agent	Finding Confirmed at Operation	No Defect in Column But Disc Found	False Defect Wrong Level	Multiple Defects; Disc Found at But One Space	Agent	No Defect	Defect in Column
Pantopaque	86	10	12	5	Pantopaque	8	17
Lipiodol	0	1	0	0			
Air	0	1	0	0			
Not given	4	0	0	0			
Total	90	12	12	5			

no-disc group would indicate that pain referred along the nerve roots may be due to factors other than actual compression by a protruded disc. We are at a loss to explain how some surgeons can make a diagnosis of a protruded disc where only back pain is present, particularly in the absence of neurologic findings. It should be noted that in many cases in which a history of leg pain was reported the distribution frequently was of non-anatomic distribution and in a few cases the distribution was quite bizarre.

Aggravation of Back and Leg Pain by Coughing or Sneezing. In the disc series ninety-seven patients gave a history of increased pain while seventeen showed no aggravation of pain on coughing or sneezing. In the no-disc series eighteen patients gave a history of increased pain while ten had no aggravation on coughing on sneezing.

The Naffziger test was used in so few cases that an analysis in this series was of no value.

Total Protein Determination. The value of this test has apparently been largely abandoned as being of no diagnostic significance. Our first series demonstrated that this test was of little value. With 40 mg. per cent being accepted as the high normal there were eight patients in the disc group with normal protein and that total protein determinations are not of diagnostic significance except to rule out the possibility of tumor.

Myelogram. Despite the fact that many surgeons have abandoned the use of the myelogram, it would appear that this procedure is still being extensively used. In this series myelography was performed in 144 cases. The results are shown in Table II. These figures indicate that the myelogram gave accurate readings in ninety-eight cases (68 per cent) and false readings in 46 cases (32 per cent). The frequent use of myelography is an indication of the diagnostic significance attached to this procedure by many surgeons. Many of the myelograms in this series have been reviewed by the author. It is obvious in some cases that any deviation in contour of the dural sac has been considered significant despite the fact that frequently such defects were found not opposite the intervertebral space but rather opposite the vertebral body. In some instances the defect was found at quite some distance from the level indicated by the clinical symptoms, and in several cases the defect was found on the side opposite to that on which the patient had symptoms. In not a few cases a positive diagnosis was made when the contrast media was obviously extra-

dural or had broken up into numerous droplets. Failure to interpret properly the findings of myelography is unquestionably a factor in the high percentage of diagnostic error as indicated in both series of our cases.

Neurologic Findings. In thirty-six cases in the disc series there were no neurologic findings while 129 patients showed evidence of changes. (Table III). Of prime interest are the neurologic findings in twenty-six of the thirty-five cases in which no disc or other disorder was found. In seven cases reflex changes, atrophy and sensory changes were all present. In two cases there was preoperative toe drop, yet in none of the patients was the surgeon able to find evidence of pathologic disorder to account for such profound neurologic changes. Many theories have been offered in an attempt to explain the presence of such findings in the absence of any disorder. In some cases the causative factor has been described as a concealed disc or a disc which has reduced itself. Whether such phenomena actually occur is debatable. In other instances the surgeon is accused of overlooking the disorder because of inadequate exposure. This may be true in certain cases but in view of the extensive laminectomies performed in the hands of the most competent surgeons, it would appear that such errors of omission do not explain these phenomena. It would seem much more likely that such neurologic changes are due to some as yet undiscovered factor. Chronic irritation of the nerve roots due to instability of the spine or pressure on the nerve roots from thickened articular capsules and degenerative changes within the facets are explanations which seem plausible though as yet unproven. In view of the findings in these cases in which no disc disorder was found, it seems reasonable to state that atrophy, reflex and sensory changes are evidence only of nerve root irritation. Their presence does not furnish conclusive proof that the cause is an intraspinal protrusion of a ruptured intervertebral disc.

TABLE III

Neurologic Changes	Disc Cases (129)	No-disc Cases (26)
Reflex changes only	34	2
Sensory changes only	18	6
Atrophy only	2	3
Reflex changes plus atrophy	3	2
Sensory changes plus atrophy	7	1
Reflex and sensory changes	47	5
Reflex and sensory changes plus atrophy	18	7
Weakness of extensor hallucis longus	4	2
Preoperative toe drop	0	2
Cauda equina paralysis	2	0

It is of interest to note the number of poor results in those patients demonstrating pain, paresthesia and numbness of non-anatomic distribution. In the disc series there were fifteen such cases; a neurosis developed in eleven patients causing them to fail to return to any type of work. Similar complications developed in five other cases. In almost every instance there was ample evidence of such neurosis before operation. In many instances in which neurosis was known to exist preoperatively, it was believed that the functional disturbances were based on organic disorder and that by correction of the latter, the functional symptoms would disappear. In all instances, however, operation served only to fix the neurosis. Our examination, therefore, should include some insight into the patient's personality and every attempt should be made to rule out symptoms of a functional nature by studying the patient as a psychobiologic whole rather than as a mere individual with backache. In the presence of inconsistent sensory findings we believe operation should be postponed.

It is obvious that the diagnosis of ruptured intervertebral disc cannot be made easily; we do not believe it can be made as a result of a single examination. It is our belief that the only way to determine the question of whether symptoms are based on operable disorder is the clinical test of conservative treatment. Ambulatory treatment with the use of belts, braces, infrared heat or diathermy we believe are inefficient from a diagnostic point of view. No patient should be subjected to operation until he has been given a period of bed rest. Leg traction, manipulation, hot packs, deep x-ray and aspirin therapy may prove beneficial. Only when symptoms persist or recur in spite of adequate conservative treatment, properly supervised and controlled, do we believe operation is justified.

The great majority of ruptured discs were found in the lowermost lumbar vertebrae:

eighty-five were found at L5; sixty at L4; twelve at L3 and one at L2. Seven double ruptures were said to have been found: six at L4 and L5, and one between L3 and L4.

In 112 cases of the disc series, disc removal alone was performed with the following results: excellent, twenty-eight (25 per cent); good, twenty-four (21 per cent); fair, twenty (18 per cent); poor, thirty-two (28 per cent); bad, eight (7 per cent). In fifty-three cases disc removal was supplemented by spine fusion with the following results: excellent, fifteen, (28 per cent); good, nine (17 per cent); fair, fifteen (28 per cent); poor, twelve (24 per cent); bad, two (4 per cent). Pseudarthrosis developed in eleven cases (21 per cent).

In twenty cases of the no-disc group exploration only was performed with the following results: excellent, two (10 per cent); good, three (15 per cent); fair, five (25 per cent); poor, eight (40 per cent); bad, two (10 per cent). In fifteen cases exploration was supplemented by spine fusion with the following results: excellent, three (20 per cent); good, one (7 per cent); fair, four (27 per cent); poor, three (20 per cent); bad, four (27 per cent). Pseudarthrosis developed in five cases (33 per cent). Thus there were poor results in 35 per cent of the cases in which disc removal alone was performed, while those supplemented by spine fusion ended poorly in 28 per cent of the cases. In the no-disc group in which exploration only was performed, 50 per cent of the patients had poor results, while those in whom exploration was supplemented by spine fusion had poor results in 47 per cent of the cases. In this series at least primary spine fusion seemed to give a slightly better result than simple removal of the disc or exploration alone.

In 112 disc cases in which disc removal alone was performed persistent symptoms led to reoperation in twenty-nine cases (25 per cent). Of these, twenty-six patients were operated upon for a second time: in fourteen cases re-exploration only was performed while twelve patients were subjected to spine fusion at the second operation. Two patients were operated upon for a third time; in one, re-exploration was performed, while the other was fused. One patient was explored four times. In two cases further surgery was advised.

In fifty-three cases in which disc excision was supplemented by spine fusion, eight patients (15 per cent) were subjected to further surgery. In two cases re-exploration was performed through the area of fusion while three patients were re-explored and fused a second time. One patient had two re-explorations through the fusion site. Two patients were reoperated upon for the repair of a pseudarthrosis. In two other cases further surgery was advised.

In the no-disc group of twenty cases in which exploration only was performed persistent symptoms led to further surgery in seven cases (35 per cent). Four patients were re-explored for a second time, one of whom was fused following re-exploration. Two patients were subjected to a third operation, one of whom was fused. One patient was subjected to four explorations. Further surgery was advised in two cases.

Of the fifteen patients in the no-disc group subjected to exploration and primary fusion, four (26 per cent) required further surgery. One was re-explored and refused. Another was re-explored through the fusion site, while two were reoperated upon for repair of a pseudarthrosis. Further surgery was advised in another case.

In sixty-eight patients subjected to primary fusion in both groups pseudarthrosis was admitted in sixteen cases (23.5 per cent). Despite failure of fusion three good results were obtained in three cases and the patients were able to do all but the heaviest work; three patients had fair results and were able to do light work. There were, however, nine poor results including all four patients subjected to operative repair. As in our previous series fusion performed as a secondary procedure gave much poorer results than when performed at the initial operation.

There were no deaths in this series as compared with five in the previous series. There were many complications, however, many of which ended in either total or partial permanent disability. (Table IV.) Some complications were unavoidable while others appeared to be due to inadequate study, radical surgery and questionable judgment both in the recommendation of surgery and in its performance. Of interest is the large number of patients who demonstrated postoperative loss of ankle reflexes. Although such loss is not a cause of disability, it is indicative of the damage that can be caused by simple exploration.

The aforementioned figures give a clear

picture of the comparative end results of the two groups. Although the end results in either group can hardly be considered satisfactory, those of the disc group as a whole were much better than the group in which no disorder was found. This is also reflected in the total period

TABLE IV
COMPLICATIONS

	Discs	No Discs
Postoperative cauda equina paralysis	2	1
Hemiplegia	1	0
Postoperative toe drop	3	1
Cerebrospinal cyst	1	0
Parkinson's disease	0	2
Paralysis of quadriceps	0	1
Sepsis of wound	4	0
Osteo of spine	1	0
Meningitis	1	0
Neurosis, psychosis	16	0
Pulmonary infarct	2	1
Postoperative loss of ankle reflexes	18	7

of disability and in the cost to the company. The total lost time from the date of disability to return to work or settlement averaged seventeen and a half months for the disc cases; for the no-disc cases, twenty-two months. The cost to the company for the average disc case was $3,740.00, while the no disc case averaged $4,793.00. As indicated previously a large percentage of patients are still on compensation. These facts do not take into consideration either the tremendous financial loss to the patient and the consequent repercussion upon his family life or the economic loss suffered by the community.

Why are these results so poor? An analysis such as this reveals many factors which shed some light on this most troublesome problem. We believe that most poor results are due fundamentally to our lack of knowledge of the mechanics of the low back. Such knowledge is absolutely essential to the understanding of the fundamental causes of low back pain. The primary function of the disc is to absorb compression forces transmitted to it in walking, bending or lifting. The disc is not constructed to withstand shearing forces. The functions of the posterior articulations or facets in the spinal mechanism are similar to the bearings in any mechanism. Abnormally placed facets produce abnormal motion, particularly hypermobility in an anteroposterior plane. Such mobility is transmitted to the disc as a shearing force. The disc, unable to withstand such a force, undergoes degeneration. Such a degeneration, therefore, is not the result of a single accident, but the result of a lifetime of abnormal stress. Subsequent to this degeneration actual rupture of the annulus fibrosus with protrusion of the degenerated disc material may occur either with or without trauma.

It would seem logical, therefore, that before operation is performed in any case in which a ruptured disc is suspected, competent neurologic and orthopedic examinations should be made, the presence of instability in the lower spine determined and a definite course of action outlined. We believe that in all such operations both a neurosurgeon and an orthopedist should participate. If instability of the low back is found, particularly in the presence of congenital abnormalities, then spine fusion should be performed. Failure to correct such instability may result in persistent and disabling back pain, although nerve root pain may be relieved. Evidence that this is true is indicated by the fact that in 132 cases in which exploration alone was performed, thirty-six cases or 29 per cent required reoperation because of persistence of symptoms. We do not believe it wise to postpone fusion and to hold it in reserve should symptoms persist or recur following the removal of the disc. Many patients will not subject themselves to secondary operation and such operations when performed are apt to produce poorer results than if performed at the time of original surgery. Although we firmly believe in the importance of spine fusion, it must be admitted that the orthopedic surgeon has much to learn in the performance of this operation if the high incidence of pseudarthrosis is to be corrected.

It has been stated that laminectomy is a harmless procedure and that simple exploration in those cases in which a definite diagnosis cannot be made does no harm. In the exposure of the disc it is necessary to excise the interspinous ligaments and the ligamentum flavum. These structures are composed of elastic fibrous tissue. Their replacement by scar tissue particularly when bone has been removed must lead to limitation of motion. This fact plus the changes in reflexes described previously indicate that simple exploration is not an innocuous procedure.

Many surgeons do not hesitate to remove much of the lamina to obtain adequate exposure. In this procedure the articular facets are often damaged if not excised. Damage to these important bearings is probably one of the most important causes of backache following simple exploration.

Orthopedists are prone to commit three errors which the author believes are inimical to a good end result. The first of these is the performance of extensive fusions; for example, from the second lumbar vertebra to the sacrum. The literature abounds in evidence that such extensive surgery leads to an extremely high incidence of pseudarthrosis, particularly when tibial bone is used. The second error is the tendency to allow fusion cases to be ambulatory in a brace two weeks postoperatively. No brace gives rigid fixation and the motion thus permitted is in all probability the cause of failure of fusion. The third error is committed when a patient subjected to fusion is returned to work three months after operation. The author believes that solid bony fusion is highly unlikely in such a short period of time.

Not infrequently arachnoiditis with its chain of symptoms is seen following the use of an iodized oil in the performance of a myelogram. Some neurosurgeons state that such a complication may follow a simple lumbar puncture. If this is true, it is ample evidence that no patient should be subjected to any procedure which might cause inflammation of the spinal theca unless the history and clinical findings indicate the need for such a procedure. Most patients with back or leg symptoms will obtain relief with bed rest. Only a very small percentage of all patients so afflicted fail to respond to conservative measures. It is, however, common practice for surgeons to recommend a myelogram after a single examination before the patient has had an opportunity to obtain relief by simple bed rest.

SUMMARY

A résumé is given of the end results of 200 patients operated upon for rupture of the intervertebral disc as a result of industrial accidents between the years 1947 and 1949. The results of this operation in industrial cases are poor and show little if any improvement over a comparable series covering the years from 1940 to 1947.

The diagnostic error in this series was 17.5 per cent indicating that the diagnosis of a ruptured disc in the average case cannot be made easily. A review of the diagnostic criteria is given including distribution of pain, effect of coughing and sneezing upon pain, total protein determination, myelogram and neurologic findings, and the fallibility of any or all symptoms, tests or findings are pointed out.

The importance of adequate conservative treatment not only as such but also as a diagnostic aid is emphasized. Some of the more common errors in the handling of such cases are discussed. The need for more effectual cooperation between the neurosurgeon and the orthopedist is stressed.

The facts pointed out in this paper are not to be construed as a condemnation of the operation for rupture of the intervertebral disc. This condition is a true pathologic entity which requires definitive treatment. The breezy attitude of many surgeons in approaching this problem, the lack of adequate study, the failure to appreciate psychologic effects of injury, the facility with which surgery is recommended and the inadequacy of its performance are to be condemned. In time it is hoped these deficiencies will be corrected; then we will see a decrease in the volume of surgery with a vast improvement in our end results.

REPLACEMENT RECONSTRUCTION OF THE HIP*

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TREATMENT of fractures of the femoral neck twenty-five years ago was such that non-union absorption of the neck and necrosis of the head were common and more likely to result than union. Other cases suggesting replacement were those in which neoplasm, tumor or trauma resulted in loss of the upper end of the bone. This inevitably led to consideration of replacement and was tried by German workers long ago who tried a variety of things including cow's horn.

Replacement of the upper end of the femur with foreign material can be accomplished if certain basic principles are understood. Reported herein are accounts of failure and success; a recording of observations in a few selected cases over a long period of time, the oldest functioning one now of ten and a half years' duration; some comment on similar efforts of co-workers; bench marks in a survey of bone reaction to foreign material replacement of the femoral head, neck and the upper end of the shaft where load stresses are tremendous; notes on the effect of form, time, function and these stresses; and basic principles which point the way to further study and accomplishment.

EXPERIMENTAL WORK

Experiments with foreign materials in bone (Bohlman[1]) led to the choice of twenty-two carat gold and platinum as usable materials. Guinea pigs were selected because of the materials cost involved and the availability of the animals. Two of each sex were used. Twenty-five years ago a spherical head was devised which was mounted on a carpet tack shank sufficiently long to protrude obliquely through the short femoral neck and intertrochanteric region. Operated legs soon displayed excellent motion and the pigs reproduced without apparent disturbance. No shank loosening occurred.

Noting minimal reaction to woods in bone (Bohlman[1]), a white oak piece was selected, soaked and boiled in Ringer's solution, dessicated in vacuum and autoclaved in bone wax. It was then turned to a well polished head on a tapered hexagonal shank and placed in a beagle hound's hip. The animal was reluctant to use her leg for two or three weeks but then became quite active, displaying good motion except in extreme ranges. Estrus cycle formed the focal point of dogs and cages were wrecked; a number of animals were lost including the four experimental hips. No trace could be found of the beagle hound. In the vicissitudes of time and moving x-rays of these experimental hips were lost.

Cost and physical characteristics made these metals unsuitable for human replacements. Wood was not strong enough. Some work was done on plating steel with them but porosity, cost of the procedure and technical difficulties prevented carrying these efforts to the clinical level.

Experiments lapsed until the remarkable work of Venable and co-workers[2] in 1936–1937, introducing Vitallium to the field of bone surgery. This was followed by Venable's article[3] on osteosynthesis in the presence of metals, and shortly after, another article by Venable and Stuck[4] illustrating a Vitallium hip cup fixed on the upper end of the femur. About the same time Hopkins and Zuck[5] published an article on Vitallium cup arthroplasty. Smith-Petersen's work[6] is fundamental in the use of hip cups of various materials, antedating in concept that of any other worker; in 1938 he used Vitallium. Venable and Stuck[7] placed a mold of this alloy in place of the upper end of the femur in a rabbit. (Fig. 1.) These accounts indicated a suitable medium for clinical work in replacement reconstruction. The Austenal Laboratories, New York City, were approached regarding research and development, and gave stimulating aid and cooperation.

Measurements were made on many skeletal pieces noting the average hip dimensions in inches. (Fig. 2.) After successful placement of the simple tapered shanks in guinea pigs a

* Read before The American Orthopedic Association, June, 1951.

FIG. 1. Vitallium mold of upper end of femur implanted in a rabbit's hip, 1936. (Courtesy of Drs. C. S. Venable and W. G. Stuck.)

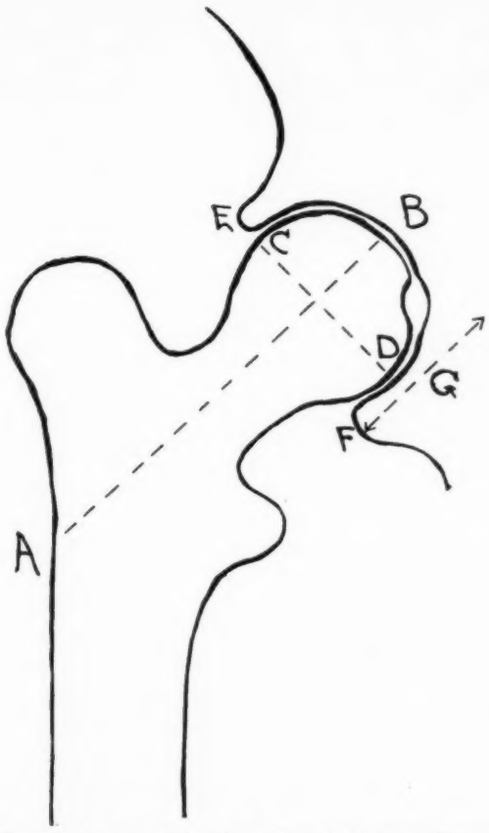


FIG. 2. Average hip dimensions in inches. AB = 3¼ to 4⅜; CD = 1½ to 2¼; EF = 1⅝ to 2⅜; G = 1 to 1¼.

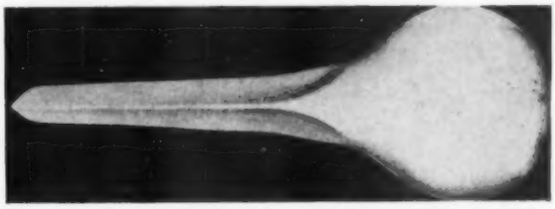


FIG. 3. First reseating femoral head and neck for human replacement, 1939.

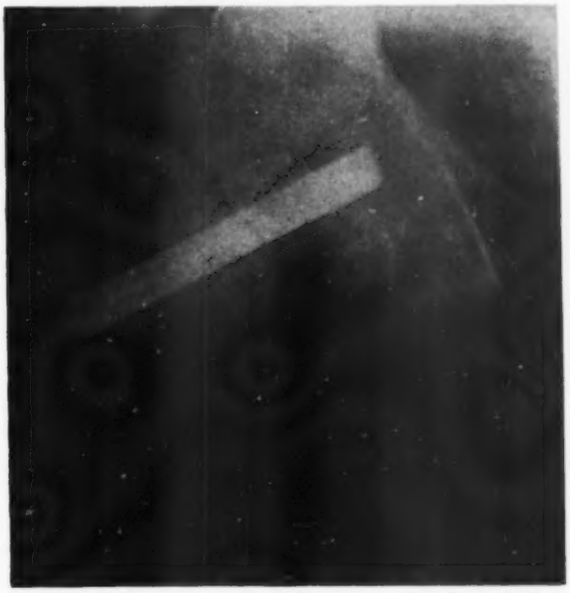
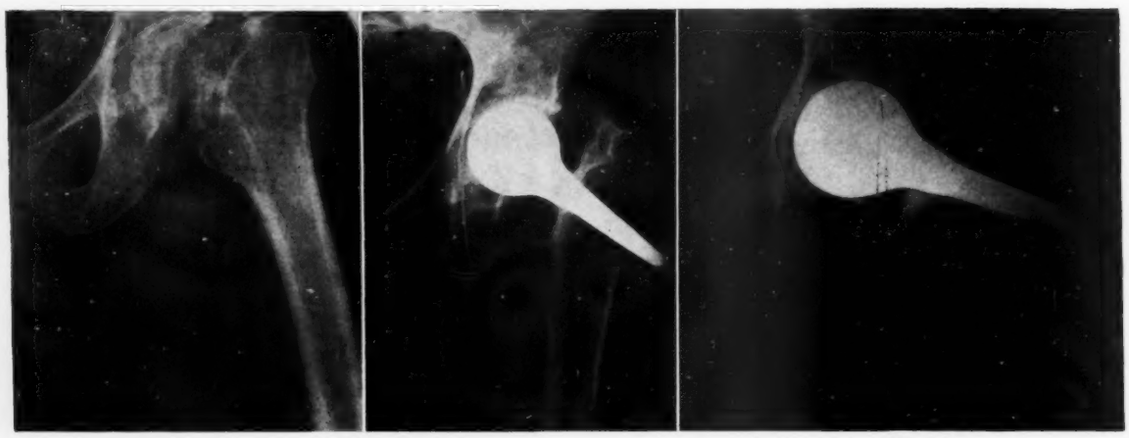


FIG. 4. Patient A. U. walking on Smith-Petersen nail after complete absorption of femoral head and neck. Note great bone buttressing about the nail. (Courtesy of Dr. H. Alvan Jones.)

three-flange shank similar to the Smith-Petersen hip nail was made; however, tests revealed insufficient bearing area and lack of surface friction. Hence the reseating or self-seating type was evolved; a triangular, gently tapered shank with the sides hollowed symmetrically to a blunt point (Fig. 3.) Noting the immense amount of bone built over the outer end of a Smith-Petersen hip nail on which a patient was walking after a dissolution of the femoral head and neck (Fig. 4), one hypothecated stimulation of bone subperiosteally on the outer side of the femur and buttressing on the inner side under the new short neck, with investment along the metal shank if it were set at a sufficiently oblique angle. Experimentation on excised cadaver femurs indicated an angle of 45 degrees or less from vertical. Tests were also made on wedging or splitting effect and on the transverse fracturing tendencies of various diameters of shanks.



5A 5B 5C

FIG. 5. A, preoperative x-ray; B, postoperative x-ray after replacement; C, final x-ray after loosening of appliance. Note shift and bone absorption.

CASE REPORTS

CASE I. E. H., a fifty-three year old woman, had an old femoral neck fracture with non-union. She was operated upon December 21, 1939, under spinal anesthesia through an anterior approach (Smith-Petersen[6]), with early

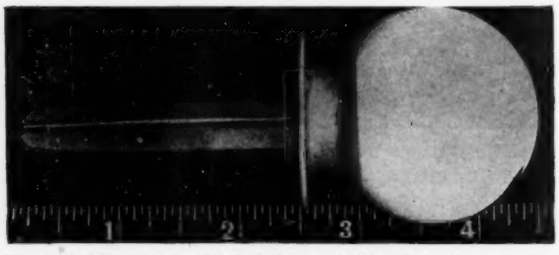


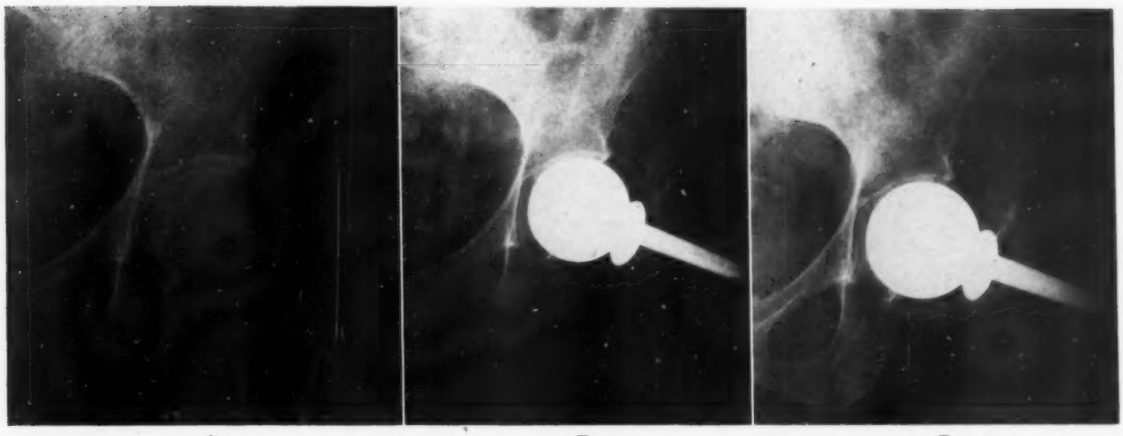
FIG. 6. Second artificial femoral head and neck for human replacement.

relief of hip symptoms. The joint became painless, quite free with excellent range of motion and continued so. The patient was started on graduated exercises, recorded increments of leg and hip activity, a daily progression of periods of movement, of amplitude, of frequency and of loads, using foot pressure on a bathroom scale for the latter. (Fig. 5A, B and C.) Highly pleased with the result through seven months until full weight bearing was approached, the patient began to complain of pain in the hip about the outer end of the spike in the soft tissues, with later instability and crippling pain which resulted from loosening of the shank. The patient refused a second operation procedure for removal of the appliance and reconstruction of her hip.

A different type of reconstructive device was designed consisting of a three-flange shank, collar or plate at the neck with a large hollow sealed head of Vitallium. Tests indicated excellent support. (Fig. 6.)

CASE II. H. B., a fifty-seven year old woman had a fractured hip of three years' duration, with non-union and absorption of the neck. She was operated upon in January, 1940, under spinal anesthesia. The operation proceeded without difficulty and smooth, painless motion with stability resulted. The patient was placed on the graduated activity course. However, as soon as loads reached near weight bearing, loosening of the shank occurred resulting in necessity for removal of the appliance. Diabetes had developed as well as a mental disorder; much scar tissue was encountered and reconstruction of the hip was not attempted. (Fig. 7.)

CASE III. While the second patient was progressing and before the period of disappointment had obtained, a third patient (M. D., aged twenty-one) presented herself with grievous disabilities from osteomyelitis. Arthrodesis of one hip had occurred with total instability of the opposite hip through loss of the femoral head. She wanted to marry but felt unable physically to carry out her duties as a wife and pleaded that we attempt to lessen her disability. She readily agreed to a metallic replacement after being informed of the possibility of failure, that a second operation for stabilization of the hip might result. She was operated upon in July, 1940, under ether anesthesia. This was a formidable procedure because of the great amount of scar tissue encountered and the necessity for reaming out an acetabulum. Considerable hemorrhage and



7A 7B 7C

FIG. 7. Patient H. B. A, preoperative x-ray; B, postoperative x-ray; C, final x-rays showing absorption about the appliance.

8A 8B

FIG. 8. Patient M. D. A, preoperative x-ray; B, postoperative x-ray.

shock resulted. At this period blood plasma was coming into vogue; two 500 cc. quantities were used resulting in laking of blood, clogging of the renal epithelium with hemoglobin and death six days later. Postmortem examination revealed excellent placement of the appliance, some hemorrhage about it and amyloid degeneration of the adrenals, spleen and kidneys, which had been undetected in preoperative tests. A type of appliance similar to the second one was utilized. (Fig. 8.)

CASE IV. At this time Austin T. Moore presented the problem of Mr. H. C., who had a recurrent giant cell tumor involving the upper end of the femur. This case was reported by us (Moore and Bohlman[8]). It presented new and greater problems in replacing the entire upper end of the femur. Again, after cadaver work, an entirely new prosthesis was made, much larger, of functional design adapting metal to muscle attachments with smooth loops in appropriate places. (Fig. 9.)

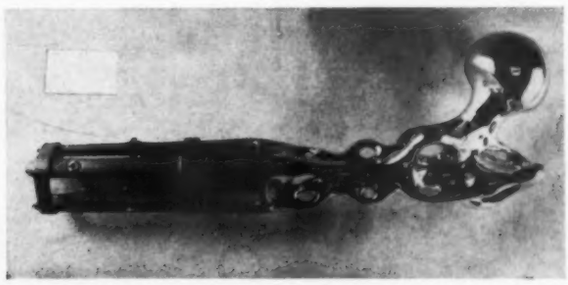
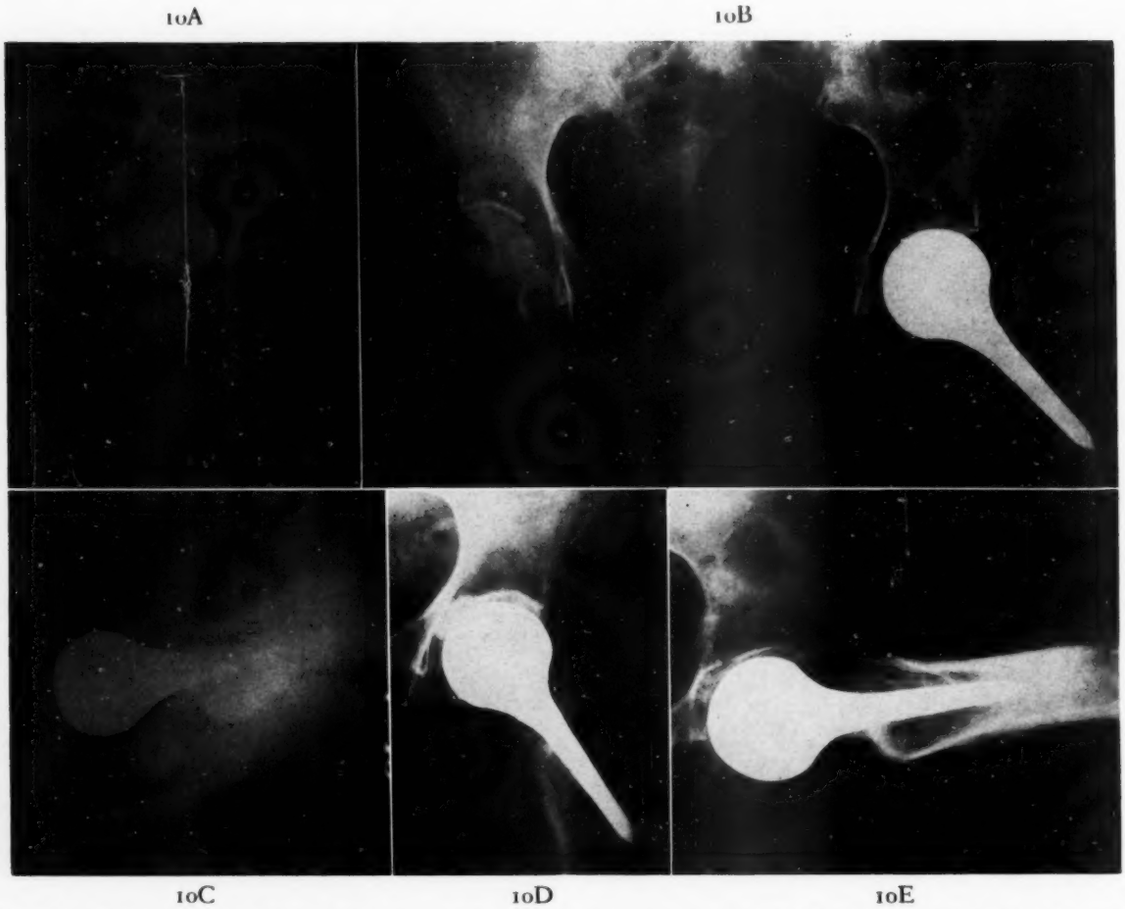


FIG. 9. First successful replacement of entire upper end of shaft. Note muscle attachment loops. (VENABLE, C. S. and STUCK, W. G. Clinical uses of Vitallium. *Ann. Surg.*, 117: 775, 1943.)

The first intricate model of wax and plaster was useless. Austenal Laboratories could not duplicate it in wax. It was remodelled entirely in wax so that plaster investment was possible; with later melting out of the wax a hollow mold was formed which had to be heated near 2,000 degrees while the molten alloy filled it under pressure. This was a complicated casting process. As previously noted, the upper end of the shaft snapped off at the end of the appliance and had to be removed after sequestration. Subperiosteal dissection caused investment of the appliance. Union between the metallic replacement and the femoral shaft took place. This appears to be the first recorded case in which muscles were made to function on replacement of bone. Postmortem, Moore found secure anchorage but after boiling out soft tissue he found the appliance somewhat loose in the bone, which would suggest a certain amount of soft tissue cushion. Bone reaction to function



10A 10B 10C 10D 10E

FIG. 10. Patient H. C. A, preoperative x-ray; B, postoperative; note angle of shank replacement with femoral shaft; contrast with normal hip; C, lateral postoperative x-ray; note range of motion; D, ten and a half years postoperatively; note even greater range of motion; E, ten and a half years postoperatively; note minimal acetabular reaction, the great buttressing and shelving of bone under appliance, the investment of shank with bone and great buttressing of point in outer cortex.

is interesting here. The tremendous angulating stresses caused dense cortical bone to build up at the junction of the shaft and the appliance, with thickening of the cortex and great buttressing on the inner side. This is apparently the first successful replacement of this amount of bone in the human body; probably the first in which a "fracture" between bone and metal healed.

These cases had a sobering effect and great consideration was given to the next.

CASE V. H. C., a seventy-one year old woman, had a fracture of the femoral neck treated with a Whitman type of cast resulting in non-union with absorption of femoral neck. With failure of our first case more vertical placement of the shank was strongly indicated and a similar appliance was used. Operation under spinal anesthesia was performed in December, 1940, resulting in free, painless, almost normal range of motion. The patient was placed on graduated activity controlled as before. During the war she felt impelled to contribute her share of activity, obtained work as hostess in a hospital and shortly gave up one crutch while attending her duties. However, even this was hampering and she sacrificed it for a cane which she was soon using chiefly to steady herself. This is the first functionally successful simple replacement of the head and neck of a femur and is now of ten and a half years' duration. A cripple was returned to comfortable productivity and self-support in spite of slight soreness and limp. It bears out one's original hypothesis regarding bone reaction to a properly constructed and placed metallic appliance. (Fig. 10.) Note the increased density and hyperplasia about the

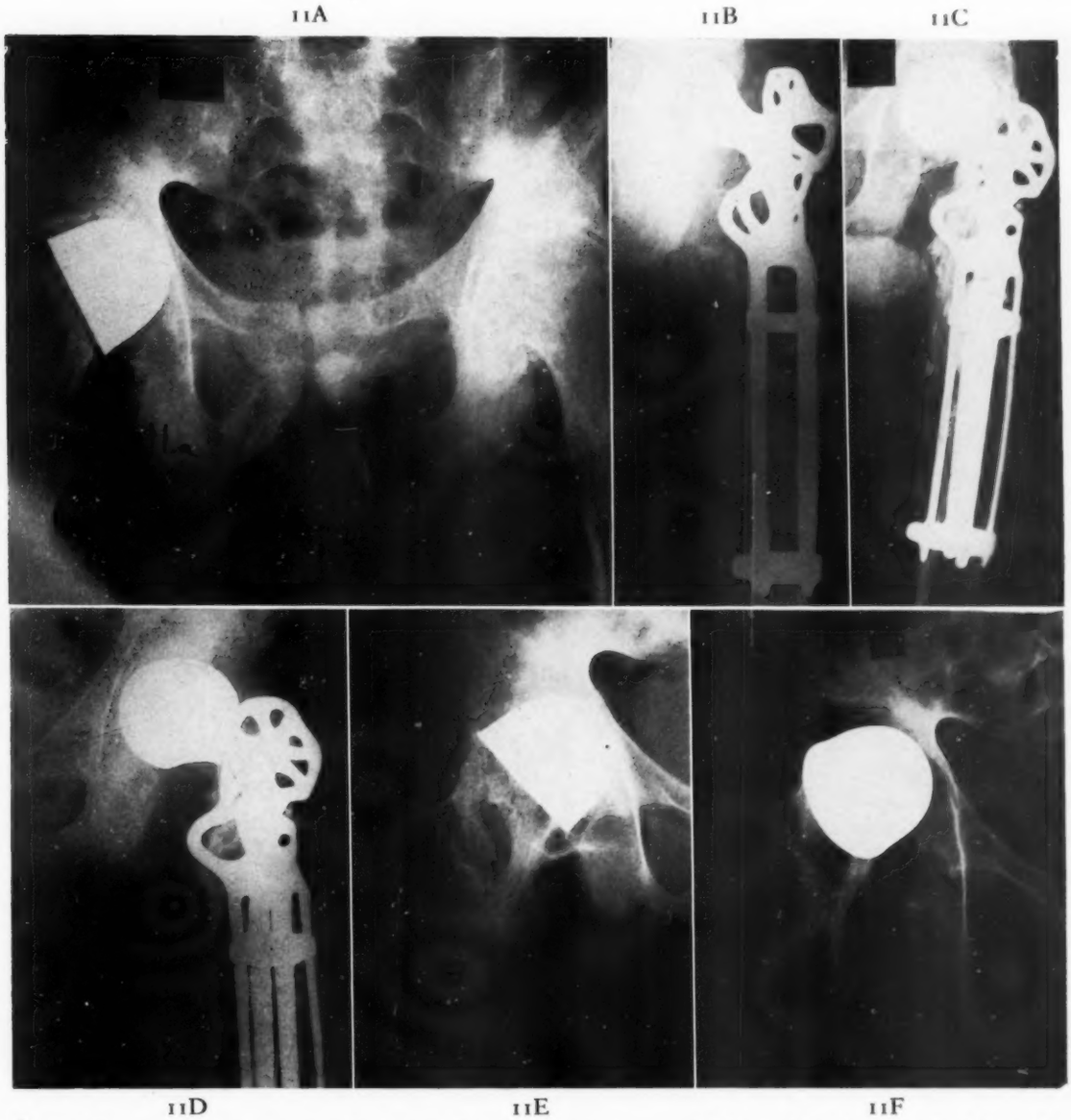
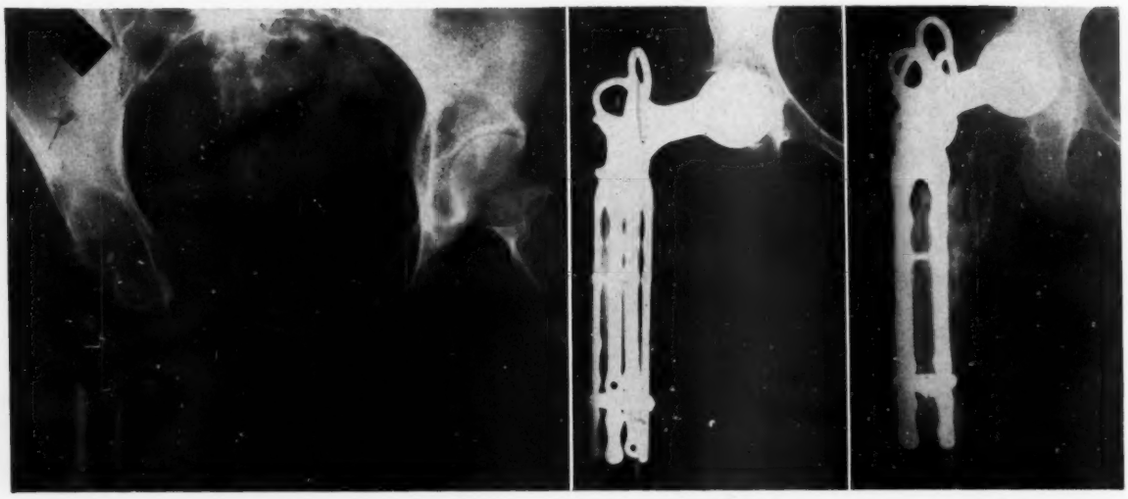


FIG. 11. Patient F. G. A, preoperative x-ray; B, postoperative x-ray with bone chips showing; C, eight and a half years postoperatively; note acetabular overgrowth of bone buttressing on inner side of shaft and at lower end of appliance and rarefaction of bone on outer side of shaft; D, x-ray after arthroplasty on metal hip; E, x-ray nine years after mold arthroplasty; F, x-ray after second mold arthroplasty.

outer end of the appliance, the sleeve-like bone investure of the shank and the buttressing, shelving upward and increased density under the neck; note the minimal acetabular reaction. A 6 degree downward shift of the appliance occurred over a period of one decade. When last seen a week after she had suffered a cerebral accident which affected her good side, she used the affected leg in preference to the normal hip.

CASE VI. F. G., a thirty-three year old man, had severe Marie-Strümpell arthritis of three and a half years' duration. A Vitallium mold arthroplasty of the right hip had been done in August, 1940, but motion was lost through massive bone overgrowth and envelopment of the hip cup. The entire upper end of the opposite femur was replaced under spinal anesthesia with substitution similar to Case IV in May, 1941. (Fig. 11.) This resulted in excellent, smooth, painless motion which disappointingly decreased and was totally lost in two years with heavy bone investure. In August, 1949, under local anesthesia arthro-



12A 12B 12C

FIG. 12. Patient A. G. A, preoperative x-ray; B, postoperative x-ray; C, current six years postoperatively; note the reaction of bone on the compression side, also about the acetabulum.

plasty was performed on the metal hip resulting again in excellent, free, painless motion, and the patient was placed on rehabilitation exercises. Pleased, he insisted on reconstruction of the right hip which was done on December 13, 1950. The head of the femur was only a fibrous, thin, cystic capsule filled with fluid under the mold. I am sorry to report that he is again slowly freezing both hips.

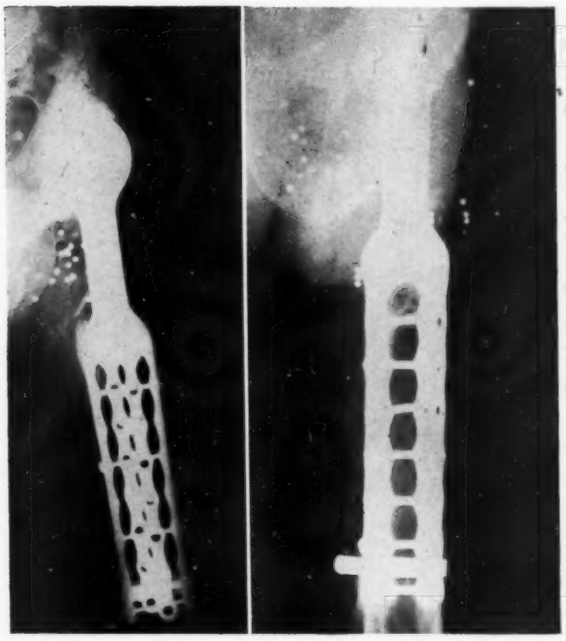
In Figure 11 note the disappearance of subperiosteal bone chips, the great overgrowth of bone on the inner side with increased density at the junction and the diaphanous bone along the outer side.

CASE VII. A. G., aged eighteen, had the upper end of the femur lost through excision of a giant cell tumor. Six months elapsed between excision and apparatus implantation in July, 1945. (Fig. 12.) Perhaps cortical bone chip pieces sequestrated. It was thought she might be sensitive to Vitallium. She stated that gold and silver jewelry caused a rash when worn. We had her tape a piece of SMO stainless steel to her body under adhesive and a piece of Vitallium in another area; these were worn for two weeks without skin reaction. The hip now has little motion; there is massive scar tissue and four or five draining sinuses. The prothesis at one area is skin deep beneath granulations.

Current x-rays show massive bone formation on inner side of shaft and appliance, branching upward, with increased density and cortical thickening at the junction. The shaft end under the prosthesis shows absorption. Great overgrowth of bone appears on acetabular borders. The patient has married, finds difficulty in getting about without crutches and uses the leg to balance herself. She is reluctant to have anything further done hoping for eventual improvement, but the outlook is gloomy. Undoubtedly the metal will have to be removed, perhaps the leg amputated. This case should have braking effect on those who embark on substitution with free enthusiasm.

Loomis[9] five years ago replaced the upper end of the femur with a spherical head on a straight staff supported by four flanges fitting over the shaft. A number of lead pellets are lodged in the vicinity. Recent x-rays (Loomis[10]) reveal minimal bone reaction about the acetabular borders. Bone on the medial side invests the flanges. It is practically non-existent on outer side. Loomis states that the patient continues to walk very well and "motion in his hip is as good now as it was two years ago." (Fig. 13.)

McBride[11] has devised an ingenious replacement. Remarkable is the trochanteric attachment, the method of embedding and the tapered threading which gives a vastly increased unit of surface pressure area and prevents wedging effect of an appliance set in the medullary canal. McBride[12] notes that where it is firmly embedded the reaction is that of proliferation, and where not firmly fixed, atrophy occurs. He calls attention to the increased density of bone about the inner side



13A 13B

FIG. 13. A, note little acetabular overgrowth with marked sclerosis over the head and bone buttressing on inner side of the appliance; B, note bone buttressing of shaft; note sclerosis and buttressing at end of appliance. (Adapted from Figure 3A in LOOMIS, L. K. Internal prosthesis for upper portions of femur. *J. Bone & Joint Surg.*, 32-A: 945, 1950.)

of the shaft at the end of the appliance and the proliferation over the upper surface, which is gratifying. His oldest case is of two and a half years' duration. (Fig. 14.) Note almost total disappearance of the bone on the outer side suggesting in time fracture through the diaphanous outer cortical surface. He reports twenty-six cases to date, including five done by co-workers, with no fracture and but one has loosened. He finds that the patients have a tendency to limp. This may be associated with the short neck and marked valgus, which is a decided mechanical advantage with regard to stresses in the shaft. McBride says those confined almost entirely to a wheelchair are very happy with free, painless movement. He comments that most of his patients, as we have experienced, complain of soreness in the hip. The reason for this is not clear. Investigative work is necessary on this topic. He recently employed a posterior approach with excellent immediate postoperative flexion and leg movement. It appears to have merit (Gibson[13]). He has used stainless steel because of manufacturing problems but is now having substitutions produced in Vitallium.

FIG. 14. Implantation of replacement of two and a half years' duration in sixty-seven year old woman. Note buttressing in upper end of shaft and on the inner side, and rarefaction on the outer side. (MCBRIDE, E. D. A metallic femoral head prosthesis for the hip joint. *J. Internat. Coll. Surgeons*, 15: 502, 1951.)

Thomson[14] reports with great enthusiasm on replacement, stating his first group of ten showed no loosening in a year following operation, with near vertical placement of apparatus. He has had thirty-five cases and is particularly pleased with them where absorption of the femoral neck has occurred. His device is strikingly similar to the author's original design. Time will tell if our wedging tests depict clinical response. (Fig. 15.)

Judet and co-workers[15] report a mushroom cap head on a stem of acrylic resin, later reinforced with a steel core. Judet and Judet[16] report 150 cases of six months to three and a half years' duration, without "osteoporosis" or loosening of stems as evidenced by x-ray studies—a remarkable series.

Peterson[18] is accumulating an extensive experience with the stainless steel prothesis designed by Jaenichen and made by Collison, which he applies in a very accurate manner. It

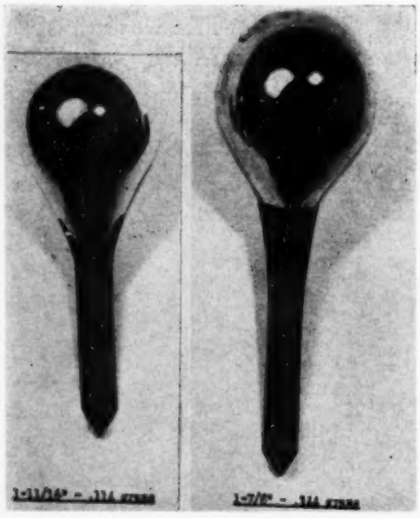


FIG. 15. Two sizes of replacement, October, 1950.

distributes weight pressure stress areas between the femoral neck section and a portion of the shank which runs about 45 degrees obliquely through the upper end of the femur and finally fixes a flange with screws on the outer side of the shaft. The author is enthusiastic regarding his results and his further reports over the next decade will be of great interest and should be informative regarding bone reaction and tolerance with this apparatus in stainless steel.

SUMMARY

For cogent reasons we felt impelled to do a few selected cases rather than a great number, believing that a long period of accurate observation and study of five to ten years or more would offer much knowledge regarding the behavior of bone and soft tissues with substitution prostheses. Certain principles now stand out sharply.

In reviewing these cases, physiologic bone response in a manner and to an even greater degree than the author had predicted is evident.

1. This can almost be stated as a law: Where angular motion at the anchorage of a replacement occurs, absorption of bone results.

2. Osteoplastic anchorage occurs with adequately fixed apparatus where sufficient weight-bearing areas of bone and metal are opposed for loads imposed. Dense fibrous tissue plays a partin this.

3. Stimulation of bone density and buttressing occurs regularly on the inner or compression side of the shaft.

4. It disappears on the outer or tension side where function is not preserved.

5. Subperiosteal pressure stimulation on the outer side causes dense bone proliferation.

6. Bone capping by an appliance with occlusion of circulation causes bone absorption.

7. Gradually increased function enhances bone response.

8. Too great loads per unit of weight-bearing area produce bone necrosis or absorption; the cut-off point between absorption and of tolerance and proliferation is not known. It may depend to some extent on age and nutrition.

9. Subperiosteal placement facilitates anchorage.

10. Large, dense cortical bone chips about the investment are not necessary and may in fact afford a locus for infection.

11. A natural acetabulum is preferable to one reamed out; it makes for a shorter, less shocking operative procedure. The artificial head should fit it well for maximum load area of joint surface.

12. Maximum muscle function should be preserved, especially with total replacements.

13. Calculated life span and physical requirements control design to a degree. The aged and feeble may require only a simple, single shank and head device, while in the younger and more vigorous the curve of life span and the curve of prosthesis migration may cross, resulting in failure and making the path of design a narrow and precarious trail.

Design Principles

1. In designing apparatus the tremendous loads involved in this area must be considered from the standpoint of the product of mass by velocity by the levers involved. Tensile stresses in femoral fractures, the work of Evans, Pedersen and Lissner[19] is informative.

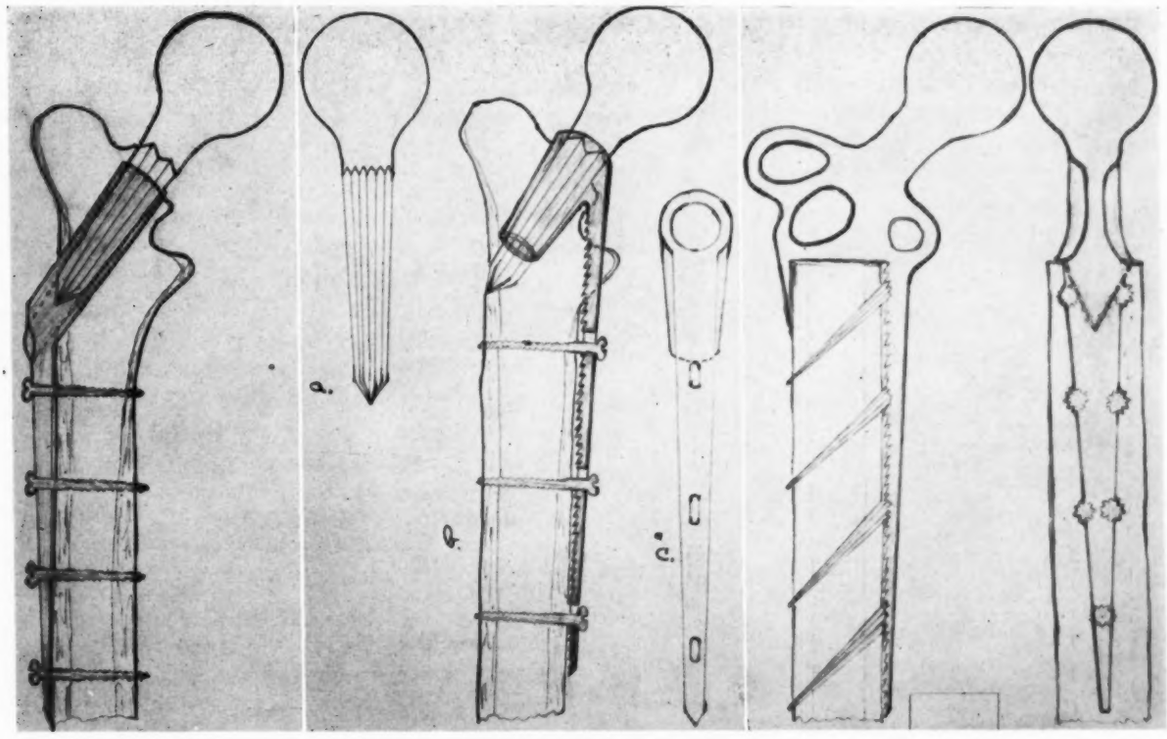
2. There must be an adequate amount of load-bearing surface area opposing an equal area of bone to prevent bone necrosis and absorption.

3. A replacement must be designed to remain fixed or reseat itself.

4. It must be so placed with regard to moments of stress and strain that physiologic response to these loads will buttress into constantly increasing osteoplastic anchorage.

5. It must stimulate function on the tension or outer side of the shaft.

6. The artificial head should be spherical



16 17 18

FIG. 16. Additional support unsatisfactory from standpoint of proven bone reaction and from tests on cadaver bone.

FIG. 17. (*a*) For simple replacement of femoral head and neck in the aged and feeble; (*b*) and (*c*) additional self-seating flange may be added if (*a*) loosens or if serviceable hip is desired. Note the slotted screw apertures; screws merely prevent rotation.

FIG. 18. Theoretically answers problems of reseating, of load distribution, of osteoplastic anchorage, of splitting tendencies and so forth.

with no discrepancy in fitting the natural acetabulum.

7. The longer the femoral neck in transverse distance to the shaft, the greater will be the angulating moments laterally at junction of shaft and apparatus.

8. The material must be non-electrolytic, non-irritative, must have known and adequate constant physical properties, and must be capable of taking and maintaining a highly polished, smooth surface.

9. Some supporting portions should be placed subperiosteally for investment and cortical bone stimulation.

10. Design should facilitate placement and hold operative procedure to minimal time.

11. Simplicity of design, minimal number of parts, and standardization from standpoint of manufacture, stocking and placement are desirable.

12. A replacement should permit freedom of function and full play of hip musculature.

Later Designs

Before these principles were clear, a supporting device investing the shank and fastening down the outer side of the shaft with screws was perfected. (Fig. 16.) It was impractical experimentally; leverage on the screw heads was unequal, each screw penetrated cortex of a different thickness and density, and screws broke or loosened. Also, it became evident that anything placed on the outer or tension side tends toward failure.

With these principles in mind the author has designed and has under construction apparatus which should fulfill requirements of simple head and neck replacements. (Fig. 17.)

Figure 17 shows a spherical head made in standard sizes, fitted to a standard neck with a round, tapered, fluted shank, cut and blunt pointed to varying lengths to match heads. This is to be used in the aged. If failure occurs or the patient is younger and more vigorous,

a flange (Fig. 17*c*) may be added as in Figure 17*b*. Note the three screws merely prevent rotary displacement and fit in slots to permit reseating. The tapered medial flange support is calculated to a thinness permitting metal resilience to stimulate tension bone integrity on outer side of shaft.

For total replacement a more daring device is underway. (Fig. 18.) Theoretically answering the aforementioned requirements, proof of clinical value rests with the future. Both appliances will be made of Vitallium and both are to be set with a jig drill.

Vitallium, "stainless steel" or rustless iron, and plastics are placed in the order of their physical values. Time and space do not permit discussion of their relative merits. Suffice it to say plastics are organic compounds and do not behave like metals. Time alone may cause them to fracture; methyl polymethacrylate is about one-quarter as hard as rustless iron.

Twenty-five years ago this work was radical, even so regarded ten years ago when the early part was presented in the Scientific Exhibit Section of the American Academy of Orthopedic Surgeons. Today it seems commonplace. Consider the risks involved. Predetermine an alternative if failure occurs. Those patients undergoing this surgery should be apprised of the possibilities. We can learn as much from our failures as from our successes. The procedure has a place. Better appliances, more adaptable and serviceable, should be our aim.

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THE BLADDER AND URETER IN GYNECOLOGY*

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ABOUT fifteen years ago one of my associates, Dr. Kickham, noted that a large number of patients with carcinoma of the cervix were being seen in consultation in our department at the Pondville Hospital because of urologic complications. This observation gave rise to an intensive study and a series of published reports devoted to this subject. Prior to this time there had been little clinical recognition of the fact that cancer of the cervix commonly involves the urinary tract through the spread of disease or as a result of treatment. The pathologists were more familiar with this process and Ewing, for example, had written that "the natural termination of most cases of uterine cancer is through uremia from occlusion of the ureters."

Our studies were based upon material drawn from 600 cases of carcinoma of the cervix at the Pondville Hospital (Massachusetts Department of Public Health) and especially 257 cases of this group in which there had been more or less complete urologic investigation. I shall quote at length from this work because it represents my earliest interest in a gynecologic problem and because it serves to emphasize the close relationships that exist between the organs of the female pelvis and the excretory passages of the urinary system. First, it will be well to refresh our minds concerning certain anatomic facts that apply to this discussion. The vesicouterine pouch of peritoneum reaches to the level of the internal os and "below this level the bladder is attached by connective tissue to the front of the cervix and the upper part of the anterior wall of the vagina." Also, according to Piersol, with whom I first became acquainted under the tutelage of Dr. Broad, "On the pelvic floor the ureter enters the base of the broad ligament, within which duplicature it is crossed by the uterine artery, passes between the veins of the vesicovaginal plexus, and continues downward and forward in the vicinity of the uterine cervix to the vagina; its terminal segment lies embedded within the connective tissue between the cervix and bladder close to the anterior vaginal wall for a distance of from 1 to 1.5 cm., where, bending somewhat inward, it reaches the posterior vesical wall." Truly the bladder and ureters can hardly escape the malignant grasp of an invasive process in the contiguous pelvic organs.

As is well known, carcinoma of the cervix commonly extends upward and laterally along the course of the ureters. I have seen cancer as high as the kidney at the time of nephrostomy for ureteral occlusion. It may grow anteriorly also, toward the bladder and, less often, posteriorly toward the rectum. It may extend along the vaginal wall and so endanger the distal ureters and the trigone. The incidence of urologic complications increases with the advance of the disease and is greater in the case of the more actively growing tumors. It is important, especially with reference to the bladder, that the local spread of the lesion may vary somewhat with the character of the growth. The proliferative or fungating or cauliflower type of tumor is often a large mass and of relatively low grade malignancy. It may elevate the floor of the bladder and thus produce the picture of extravesical pressure on cystoscopic examination; through its size it may protect the bladder somewhat during irradiation. The invertive or endocervical type of tumor may remain localized in the cervix for a relatively long period. The ulcerative type is usually of high grade malignancy and is more likely therefore to invade the bladder.

The appearance of the bladder at cystoscopy will vary with the extent of the growth in the cervix and especially with its progress in the anterior direction. It may be normal. There may be elevation of the trigone and posterior wall by the extravesical pressure of the advancing tumor, somewhat similar to the uterine eminence commonly seen in the floor of the normal female bladder. When there is edema

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FIG. 1. Pyelogram showing ureteral stricture with hydronephrosis and hydroureter in a case of carcinoma of the cervix.

of the mucosa overlying this elevation, it implies that the neoplasm is close to the bladder wall or that actual invasion has occurred. With more advanced stages of vesical involvement submucosal nodules may be seen or definite tumor. The final phase of this destructive process, as far as the bladder is concerned and if the patient lives long enough, is a vesicovaginal fistula.

It is essential to accurate diagnosis and effective treatment that we examine the bladder in all cases of carcinoma of the cervix. It is not safe to depend upon symptoms of bladder dysfunction since they may be absent or misleading. Increased frequency or dysuria or even mild degrees of incontinence may result from nothing more serious than extravesical pressure or simple cystitis. If it has been demonstrated by pelvic and cystoscopic examinations that the bladder is involved by the disease, the cure of the patient may still be possible and should still be sought by the most vigorous means at our command. If the treatment is surgical, the bladder may be included in the mass to be removed. If radium and x-ray are used, bladder ulceration or even fistula may be produced in the area already devitalized by tumor or scar but such lesions are not important if the disease can be cured. One sixty-five year old patient in whom a large vesicovaginal fistula developed after irradiation was relieved of her incontinence by transplantation of the ureters to the large bowel. She was living and well at the last report four and a half years later. Another patient lived with a nephrostomy tube for twelve years and eleven months without recurrent disease, after severe necrosis of the trigone and bilateral ureteral stricture following the use of radium.

The late irradiation changes in the bladder, apart from fistula, may vary from minor disturbances of blood supply with areas of avascularity and telangiectasis, to actual ulceration from ischemic necrosis. Such an ulcer, usually in an area close to the cervix, may develop months or years after treatment. It is not common—we found twelve in our original study—but when it occurs, it is disturbing until its identity is established. The correct diagnosis is suggested usually by the sudden onset of frequent, painful urination with hematuria in a patient who has had radium therapy for cancer of the cervix some months or years before. In our cases the average period from the time of irradiation treatment to the beginning of ulcer symptoms was 2.25 years; the shortest time was 0.7 years and the longest 5.5 years. As might be expected, retreatment with radium or x-ray increases the risk of bladder injury as compared with the initial therapy because it leads to further endarteritis and scar in an area already devitalized by vascular damage.

In the natural history of carcinoma of the cervix there is eventual spread to the broad ligament areas and the pelvic lymph nodes. Almost inevitably the ureters are involved in this upward extension and they become occluded, in mild or marked degree, by edema or pressure or actual invasion by the tumor. Unless this process is interrupted by effective treatment, certain definite and irreversible changes develop in the upper urinary system. These changes are marked by dilatation and atony of the obstructed ureter, hydronephrosis, progressive impairment of kidney function, and ultimate renal death. This deterioration is hastened by the advent of infection, invited as always by stagnant urine. We found the average level of ureteral obstruction to be 4 to 6 cm. above the orifice in the bladder and that orifice, on cystoscopic inspection, may be normal in appearance. (Fig. 1.)

Here again, symptoms may be strangely lacking. There may be renal pain, typical in its

distribution. Low, hip-encircling pain has been thought to result from ureteral stricture in these cases but I suspect that it is caused more often by spreading tumor in the pelvis. It is important to emphasize that in this as in other conditions the death of a kidney may be silent. Advanced chronic pyelonephritis may exist without pain or tenderness or palpable enlargement of the kidney on abdominal examination. In the later stages of the disease the systemic effects of pyelonephritis will be shown and, when both ureters are occluded, the progressive signs and symptoms of uremia. These may be mild or marked as in any toxic state and may vary from the earliest manifestations of toxemia to the late changes associated with anuria and rapidly rising levels of azotemia. We have learned that the simple test of renal function with phenosulfonphthalein may detect the degree of kidney failure in uremia before the elevation of blood nitrogen reveals the true condition.

It is obvious that urologic investigation should be included in the study of every case of cancer of the cervix before treatment is instituted, to define more accurately the clinical stage of the disease, to aid in the prognosis, to provide a base-line for comparison with later observations and most of all to render the treatment more effective and safer by determining in advance the extent of bladder or ureteral involvement. The edema of irradiation, for example, might complete a partial and perhaps unsuspected occlusion of the ureters and there is less danger of surgical complications if all the facts are known before operation is undertaken. The bladder should be examined. Renal function tests should be done. X-ray studies should always be made and retrograde pyelograms are usually more accurate than those made by the intravenous method. The damaged kidney may not excrete dye well enough to fill its excretory channels. We learned also that the simple passage of a catheter does not exclude the possibility of ureteral narrowing by edema or tumor, sufficient to produce dilatation above the level of stenosis.

There are various methods of treatment for the obstructed ureter in these cases. The simplest method, where it can be employed, is dilatation with a catheter at cystoscopy. This is effective when the stricture results from fibrosis, due to infection or late irradiation reaction or tumor replacement by scar. It is not effective when the obstruction is produced by carcinoma and the attempt may cause bleeding or further occlusion by edema. Plastic operations upon the ureter and transplantation to the large bowel are seldom justified under these circumstances and the pelvis which has been involved in malignant disease usually does not offer a suitable field for these procedures.

The most common operation that we have performed for the relief of ureteral obstruction, in cases of uterine cancer, is nephrostomy. Direct drainage of the kidney by nephrostomy is one of the most valuable operations in urologic surgery. It preserves the function of the obstructed kidney and in many instances it saves life. If necessary it may provide a permanent channel for the outflow of urine; frequently it is a temporary measure which leaves the way open for later reconstructive efforts to free the strictured ureter. We discussed this operation a number of years ago in a report written with my associate Dr. Buddington. We listed ten different indications for nephrostomy at that time but we have performed it most often for the relief of ureteral obstruction in cases of malignant disease in the bladder or female pelvis. Emergency bilateral nephrostomy has been required, on occasion, where both ureters were occluded with resulting anuria and all the signs and symptoms of profound uremia. Nephrostomy is a simple operation which may be performed in the presence of critical illness and under local novocain anesthesia if necessary. I can hardly recall a single instance of surgical fatality following this procedure. (Fig. 2.)

It is of interest to comment briefly on the striking ability of an obstructed kidney to regain its functional value when normal urinary drainage has been established. Remarkable improvement may be expected in most cases even when severe impairment of function has occurred, and conservative efforts to spare the organ are amply rewarded by this life-saving phenomenon. The recovery of the kidney and of the blocked ureter is less certain in the presence of extensive prolonged infection.

The need for the sacrifice of a kidney is infrequent and is seldom justified under these circumstances except perhaps for severe pyelonephritis which cannot be controlled by drainage or when in an otherwise cured case, a normal kidney on one side warrants the removal of its damaged mate. In the long series

FIG. 2. Pyelogram showing preservation of obstructed kidney by permanent nephrostomy following serious ureteral injury in a case in which it was necessary to remove the other kidney for malignant disease.

at Pondville, to which I have referred, there were two nephrectomies. Dr. Quinby used to say that nephrectomy is a destructive operation and a confession of failure on the part of the surgeon. I am impressed, if I may generalize at this point, by the rarity of this operation as compared with twenty-five years ago. It is one of the notable advances of modern surgery that the majority of kidneys that come to the operating room nowadays can be saved in one way or another. Perhaps the time will come when nephrectomies will not be performed except after consultation and in the face of dire necessity.

The natural course of uterine cancer has not changed but the urologic complications of this disease and its treatment are becoming less frequent. The best explanation that I can offer for this favorable trend is that earlier diagnosis and better study in these cases have led to more prompt and effective therapy. It may be true also that surgery is replacing irradiation to a considerable degree and that we may be escaping some of the effects of radium and x-ray as far as the bladder and ureter are concerned. Certainly most of these patients that I am now called upon to see have suffered surgical injuries.

The bladder and the ureter are easily injured in the course of pelvic operations, whether for malignant disease or for some benign condition. It is safer to know the state of these organs before difficult pelvic dissections are undertaken. The ureter may be traumatized by clamp or ligature. The results may be obvious at once or may appear later when necrosis occurs or when signs of obstruction develop within the kidney. The ureter may be cut or a portion of it may be excised. I recall the case of a pupil nurse whose surgeon learned from the pathologist that a segment of ureter was contained in the specimen removed at the time of a presacral neurectomy. The abdomen was re-entered promptly. The two cut ends were released from their attachments and brought together without tension. The ureter and the patient and, I might add, the gynecologist made a satisfactory recovery.

The ureter is a remarkable organ. It will heal if given a reasonable opportunity and peristaltic activity will go on in spite of scar. It has a rich blood supply from multiple sources and it may be lifted from its bed for a considerable distance without ill effect if its adventitia and muscle wall are left undamaged. A break in its continuity from any cause will be followed by extravasation of urine and subsequent obstruction. These constitute the serious results of such an injury. The escape of urine alone is not disastrous if free extraperitoneal drainage is established by surgery or by the prompt development of a fistula. The obstruction which may follow is more serious because it affects the kidney. I think I have never seen a ureterovaginal fistula, for example, without obstructive changes, usually associated with infection, in the kidney and ureter above the level of the lesion. The greatest danger in ureteral injury, as has been said, lies in failure to recognize that it has occurred.

The ureter can be repaired at the time, in most cases, if it is known to have been cut or clamped or tied. The two cut ends or the two ends remaining after excising the traumatized segment can be brought together usually, without tension. A satisfactory method is first to pass a ureteral catheter which should be small enough to fit loosely, upward to the kidney and its other end downward into the bladder. A direct anastomosis is then performed over

this catheter with the minimum number of very fine chromic catgut sutures. An attempt is made to avoid the mucosa in placing these sutures. A drain is led to this region, outside the peritoneum which should be closed over this area. The catheter is withdrawn from the bladder, several days later, by means of cystoscopic forceps when the anastomosis is sufficiently healed. If the injury is so close to the bladder that this procedure is impractical, or if the distal extremity cannot be found, a catheter may be passed upward through a cystoscope to aid in establishing continuity by the same technic. In such cases a polyvinyl catheter is useful because its rigidity helps to keep it in position for constant drainage during the period of healing.

When the defect is too great or when the distal extremity of the ureter is too involved in disease or scar to permit a satisfactory anastomosis, direct repair is not possible. The ureter may then be transplanted to a new location in the bladder if these two structures can be made to meet without tension when the bladder is empty and the maximum length of ureter is required. Ureterovesical anastomoses were often unsuccessful because of stricture from infection and fibrosis before the days of the antibiotics but better results may be expected under present day conditions. (Fig. 3.) Great care must be taken to avoid infection. A small soft rubber catheter, introduced through the suprapubic incision, is passed through the new ureteral orifice to the kidney level and is left in place for at least three weeks. Together with the suprapubic tube which drains the bladder.

The length of undamaged ureter after severe injury and the condition of the pelvis and the state of the patient are not likely to favor transplantation to the bowel as a solution for this problem. I have never used this operation under these circumstances. Ligation of the ureter, in the hope that silent atrophy of the kidney will occur, is not justifiable. This sacrifices an organ that the patient can ill afford to spare and perhaps without full knowledge of the state of the other kidney. A urinary fistula may still ensue, moreover, or pyelonephritis may supervene instead of the symptomless atrophic changes that had been expected.

The most common postoperative evidence of ureteral injury in gynecologic cases is incontinence from a ureterovaginal fistula. This is a distressing complication which keeps the patient constantly wet although the product of the other kidney is still passed normally. It seldom heals spontaneously and, as I have said, it always leads to dilatation, usually accompanied with infection, in the upper urinary tract on the side of the injury. Communication with the bladder is interrupted by the stricture which develops inevitably at the point of the fistula. Even with profuse discharge of urine from the vagina, the fistulous tract does not drain freely enough to prevent ureteral dilatation and renal damage. In certain of these cases deliberate sacrifice of the kidney may be expedient if normal conditions are present on the other side and if the possibility of successful repair seems doubtful and if the circumstances of the patient do not favor the prolonged disability that may be necessary for the reconstructive program.

FIG. 3. Three-minute intravenous pyelogram four and a half years after transplantation of the ureters to the large bowel. Patient had extensive vesicovaginal fistula caused by irradiation for cancer of the cervix.

The complications that involve the bladder in gynecology are similar to those that affect the ureter. Here also the disease processes concerned are more often neoplastic than inflammatory. The bladder is not disturbed as a rule by infections in the pelvis and it is remarkably

FIG. 4. Intravenous pyelogram nine months after operation in a case of transplantation of the ureter to a new position in the bladder on the right side, because of a complete stricture following hysterectomy.

resistant to the influence of scars and adhesions. Even the severe changes of endometriosis are not usually productive of serious vesical dysfunction. Actual endometrial lesions in the bladder were found by Holmes in only two of the cases which he reviewed, but ureteral strictures occurred in eight of his patients.

Surgical injuries of the bladder are common and most of them, if recognized and repaired promptly, cause no further difficulty. It is easy to incise or tear the bladder during a pelvic operation but careful suture of such minor wounds and a period of catheter drainage are usually sufficient to produce healing.

The most serious bladder injury occurring in gynecologic surgery is that which results in a vesicovaginal fistula. It may become apparent through urinary leakage immediately following the operation. It may develop later from necrosis in the bladder wall due to trauma at the time of operation. It is an evidence of the progress in obstetrics that this complication is no longer most common in that field.

Vesicovaginal fistulas, with the exception of those due to irradiation or an active, destructive disease, can be repaired successfully in almost every instance. In a report written in collaboration with Dr. Phaneuf we recently reviewed forty cases. In only one did incontinence from the fistula persist and in only six of the cases was it considered necessary to abandon the bladder and transplant the ureters to the bowel. All of the six survived and four are still living, but such radical treatment should be the last resort in the management of vesicovaginal fistulas. Greater experience will reduce still further the number of patients for whom it is necessary. (Fig. 4.)

The improved results now obtainable are due to better surgical technic and better control of infection. Dr. Phaneuf has developed an excellent method for the closure of these fistulas. It is essential always to delay the operation until the inflammatory reaction in the tissues around the fistula has completely subsided. The most important suggestion that we made in our report, from a urologic point of view, is that suprapubic drainage should be provided for the bladder following the repair of difficult vesicovaginal fistulas, or as a part of the treatment of any serious bladder injury. This is the safest and most certain way to keep the bladder empty for as long as may be necessary to complete the process of healing. The suprapubic tube, in contrast with the urethral catheter, drains constantly because it stays in place and is not readily occluded. It does not rest upon and irritate the region of repair. It lessens the likelihood of infection and does not produce urethritis. In our cases the average duration of suprapubic drainage after repair of the bladder is three to four weeks. In the presence of a normal bladder outlet a suprapubic sinus will close promptly if the opening is high in the dome of the bladder and at a high level in the abdominal wall.

Full regard for my title might lead me to consider next such manifestations of the relaxed pelvic floor as cystocele and stress incontinence. I shall carefully avoid them since in Boston at least they constitute a special privilege in the department of gynecology.

Instead, and in closing, I would like to devote a few lines to the simplest of all urologic procedures, catheterization of the female urethra. Although this seems of slight importance, it deserves our attention because it is so fraught with possibilities of harm as well as good. No instrument that we use is more familiar than the catheter or more indispensable or more

often entrusted to unskilled hands. We see too many patients whose surgical benefits are obscured by urinary tract infection and the distressing symptoms of urethritis caused by catheter drainage.

The so-called routine order is often a poor thing in medicine and I am especially opposed to the routine catheterization of patients after operation. A catheter should be passed, not when a certain number of hours have elapsed, but when fluid intake and diuresis and lack of ability to void have combined to produce a full bladder. To be sure the patient must be watched and careful judgment is essential because the bladder muscle may become atonic through prolonged distention and lose, temporarily, its power to contract.

If it becomes necessary to pass a catheter after operation, it is wiser as a rule to leave it in place for constant drainage until the patient and the bladder recover normal control. Catheterization once is better than repetition because it diminishes trauma and lessens the likelihood of infection. At best an indwelling catheter is a foreign body and it should always be small enough to permit drainage around it of the products of inflammation that result from its presence in the urethra. No. 18 or 20 French is ample for the female patient and large enough for the free flow of clear or cloudy urine. Everything pertaining to the catheter and the drainage system, including the bottle, should be sterile and should be cared for with every effort to protect the bladder against infection. Dr. Buddington has shown in recent studies that bacteria frequently gain access to the bladder through backflow from a contaminated bottle. An irrigation carelessly managed affords another opportunity for the introduction of infection and is seldom necessary. Catheter irrigation is often a matter of routinism and tradition. Its benefits are doubtful in the average case. The best irrigation for a bladder on constant drainage is a high fluid intake.

The responsibility for catheterization should be assigned to the nurse with the most training and preferably one with gentleness as well as skill. It should not be entrusted to the lowliest student. It is difficult to catheterize a female bed patient without introducing infection. A good rule that has been proposed at the Deaconess Hospital in Boston is that two nurses shall be required to carry out this procedure, one to cleanse and expose the field and the other to pass the catheter.

Finally, we must not forget to acknowledge the blessings afforded by chemotherapy and the antibiotics, both for prophylaxis and for cure. To use them most effectively, we must be guided by bacteriologic reports at frequent intervals. The urine should be cultured always before catheter drainage is discontinued so that suitable terminal treatment may be prescribed. Every effort should be made to send the patient home with all wounds healed and with neither signs nor symptoms of infection in the urinary tract.

SUMMARY

The urologic complications of carcinoma of the cervix and their clinical management have been reviewed.

Injuries to the bladder and ureter resulting from pelvic surgery have been discussed and methods of repair have been suggested.

Attention has been directed to the urethral catheter and the importance of its proper use in the prevention of postoperative infections.

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HASHIMOTO'S DISEASE (STRUMA LYMPHOMATOSA)

A FAMILIAL INCIDENCE OF THREE CASES

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STRUMA lymphomatosa was first described in 1912 by Hashimoto,[10] a Japanese surgeon, who reported four cases, all occurring in elderly women. Since the appearance of his paper lively interest in this unusual type of thyroiditis has been stimulated. In 1931 Graham and McCullagh[9] collected 104 cases; 95.8 per cent of the patients were women and the average age at which the symptoms first appeared was 52.4 years. Joll[11] in 1939 reported fifty-one cases in 5,650 thyroidectomies. In 1942 McSwain and Moore[17] reported seventy-one cases in 11,049 operations on the thyroid. Chesky, Dreese and Hellwig[1] (1931) reported 146 cases of Hashimoto's disease in 2,031 patients requiring thyroidectomy.

A total of 563 cases of struma lymphomatosa have been recorded since 1912, about one in every 116 goiters, or slightly less than 1 per cent. The sex ratio of female to male patients was 28:1 and the average age was 49.2 years.

An exhaustive search of the literature failed to disclose any mention of the familial or hereditary tendencies of Hashimoto's disease. This observation prompted a recording of a series of three cases occurring in full sisters, whose ages were twenty-seven, thirty-three and thirty-five, respectively. Inasmuch as struma lymphomatosa is seldom diagnosed preoperatively, a discussion of this comparatively rare form of thyroid disease seems warranted.

Histogenesis. Nothing conclusive is known of the etiology of struma lymphomatosa although Chesky, Dreese and Hellwig[1] hypothesize that an excess of pituitary thyrotropic hormone causes an invasion of the intrafollicular colloid of the thyroid by wandering cells which gradually ingest the colloid by a process that they term "colloidophagy." The colloid is changed in such a way that it attracts macrophages by chemotaxis. They have demonstrated with an electron microscope significant changes of the colloid occurring in Hashimoto's disease. Actual gaps were noted between the follicle cells through which these wandering cells pass. No epithelial degeneration was observed in this stage. However, as the follicles collapsed, assuming oval, triangular and slit-like lumens, with the disappearance of colloid, a syncytial mass of cells, apparently macrophages with pyknotic nuclei, fused. Some of these macrophages with ingested colloid leave the follicle lumen and re-enter the general circulation; others, too loaded with colloid, become stranded in the interfollicular stroma and there degenerate, with the result that with a chemical change more lymphocytes than macrophages are attracted. The packed accumulation of lymphocytes around and between the follicles interferes with the blood supply and nutrition of the follicular epithelium which is finally destroyed. Whole or isolated areas are then replaced by fibrous tissue. In addition, there is a formation of large acidophilic cells with excessive granular cytoplasm and hyperchromatic nuclei. These are polygonal in shape and resemble hepatic or adrenal cells, and are variously described by Womack[31] and others as "Hürthle cells." A histopathologic diagnosis of Hashimoto's disease should rest upon these epithelial changes rather than on the amount of lymphoid tissue present. Fibrosis is not necessarily prominent and may be related to the duration of the disease.

Pathology. There are three distinct types of thyroiditis predicated on gross and microscopic findings: (1) struma lymphomatosa of Hashimoto, (2) Riedel's struma and (3) subacute thyroiditis of de Quervain or struma granulomatosa with giant cell variant. Many contemporary authors are of the opinion that Hashimoto's disease is a separate clinical and pathologic entity from Riedel's struma or subacute thyroiditis of de Quervain. Among those favoring this premise are Hashimoto,[10] Lee and McGrath,[14] Graham and McCullagh,[9] J. G. Lee,[13] McClintock and Wright,[15] Joll,[11] Moore and Lloyd,[18] and McSwain and Moore.[17]

Those opposing this controversial stand are Ewing,[6] Williamson and Pearse,[30] Eisen,[7] Womack,[31] and Chesky, Dreese and Hellwig.[1] This latter group states definitely, "There are only quantitative differences between the severe grades of chronic thyroiditis. Both show the same morphologic characteristics, the only difference being the intensity."

Shilling[27] presented a comprehensive picture of the pathologic changes which take place in a thyroid being converted by some obscure combination of factors to a lymphadenoid type of goiter (the apt term applied to Hashimoto's disease by Williamson and Pearse[30]).

The thyroid in Hashimoto's disease is diffusely enlarged, has a resilient feel and may proceed posteriorly and encircle the trachea. Such a case was reported by Oldfield[19] in 1947. The gland is smooth, pink and beefy and has a pseudolobulated appearance. The cut surface is finely lobular with a yellowish cast. Microscopically there is a uniform degeneration of all the acini which are multishaped and shrunken. The epithelium is pale, flattened and finally degenerated with eccentrically placed nuclei. Colloid is scant to absent. Numerous lymph follicles and plasma cells are seen. Vascularity is greatly diminished and there is a diffuse infiltration of lymphocytes throughout the gland and between the acini. Fibrosis increases as the disease progresses, assuming waving whorls about the lobules.

Struma lymphomatosa must be differentiated pathologically from the following: (1) chronic non-specific thyroiditis, (2) chronic specific thyroiditis—tuberculosis, syphilis and actinomycosis, (3) lymphosarcoma, (4) carcinoma, (5) Riedel's struma and (6) de Quervain's struma.

A table showing the pathologic differences between struma lymphomatosa and the strumas of Riedel and de Quervain has been prepared. (Table 1.)

TABLE 1

SALIENT PATHOLOGIC FINDINGS IN HASHIMOTO'S, RIEDEL'S AND DE QUERVAIN'S STRUMAS

	Struma Lymphomatosa	Riedel's Struma	de Quervain's Struma
Gross appearance	Pseudolobulated yellowish cast	White, smooth	Gray, white, smooth
Bleeding tendency	Variable	Decreased	Usually decreased
Extent of involvement	100 diffuse	⅓ unilateral	⅓ unilateral
Adjacent structures	Pretracheal only	Always involved, generalized, very dense	Variable, usually none
Consistency	Firm	Very hard, bone-like	Hard
Presence of adenomas	Occasional	Occasional	Occasional
Microscopic acinar epithelium	Degenerated, low cuboidal, compensatory focal hyperplasia, frequent	Compressed, absent areas, normal elsewhere	Marked, acute degeneration in involved areas, normal elsewhere
Colloid presence	Scant to absent	Normal in uninvolved areas	Normal in uninvolved areas, decreased in involved areas
Cellular infiltration	Diffuse, lymphocytic lymph follicles with germinal centers	Moderate number of lymphocytes and leukocytes in fibrotic planes	Decreased lymphocytes and leukocytes, pseudo giant cells, plasma cells, histiocytes
Blood vessels	Uninvolved	Thickening of intima and media; periarteritis fibrosa	Slight or none

Diagnosis Two of our three cases were diagnosed preoperatively but from our observations it may be stated conclusively that if a smooth, firm goiter appears in a patient (usually a woman), reaches its maximum in size in a few months, involves every part of the gland and produces moderate dyspnea but no serious pressure effects or thyrotoxic symptoms, pain, tenderness, pyrexia or other inflammatory phenomena, it is almost certain to be Hashimoto's disease. If to these features are added the absence of involvement of extrathyroid tissues and the presence of some degree of hypothyroidism, the diagnosis is further substantiated.

FIG. 1. Three sisters (Cases I to III) who underwent successive thyroidectomies for Hashimoto's disease.

The clinical characteristics differentiating struma lymphomatosa, Riedel's struma and de Quervain's struma are presented in Table II.

Treatment. Many authorities agree that surgical extirpation of the gland is the treatment of choice and is especially indicated when the diagnosis has been established preoperatively and when obstructive symptoms are apparent. However, x-ray therapy may bring about optimal control without the hazards of temporary or persistent hoarseness and the eventual development of mild to severe myxedema.

The operative results in our series, although small, have been gratifying. A total of seventy-five thyroidectomies were performed at Hillcrest Memorial Hospital over a five-year period. Among those were ten proven cases of Hashimoto's disease, three of Riedel's struma and one of de Quervain's subacute thyroiditis. The average age for Hashimoto's disease (14 per cent) was thirty-one years, for Riedel's struma (4 per cent) forty-six years and for de Quervain's struma (1 per cent) twenty-nine years. All of the individuals treated surgically for Hashimoto's disease were women. Three of the ten patients were from one family. (Fig. 1.)

CASE REPORTS

CASE I. (No. 13898.) Mrs. W. Q., a twenty-seven year old white woman (para II, gravida II), was admitted to Hillcrest Memorial Hospital on April 4, 1951, with the chief complaint of painless swelling in the neck. Approximately four months prior to admission the patient first noticed a mass in her throat which continued to enlarge and lately produced a sensation of choking. There was no history of tremor, palpitation, weight loss, heat intolerance or previous operations. She had had the usual childhood diseases.

Physical examination revealed a well developed, well nourished adult white female who did not appear acutely ill. Her blood pressure was 102/70 and the pulse 76. The skin was warm and dry. The thyroid was symmetrically enlarged, freely movable in the surrounding tissues, firm and smooth and not tender to palpation. Exophthalmos and tremor were absent. There was no cervical adenopathy.

The laboratory data were as follows: basal metabolic rate, +3; red blood cells, 3,820,000; hemoglobin, 12.5 gm ; white blood cells, 8,750; differential, normal; Kline test, negative.

Surgery was indicated because of pressure and for cosmetic reasons. The preoperative diagnosis was simple colloid goiter.

Lugol's solution (10 drops three times per day) was given for two weeks preoperatively to reduce glandular vascularity. A subtotal thyroidectomy was performed under cyclopropane endotracheal anesthesia. Approximately 24 gm. of tissue were removed in the resection of four-fifths of the right and two-thirds of the left lobes.

The pathologic report was as follows: "The

obulated structure of the thyroid is well preserved. The individual lobules show great variations in size but their general structure is rather uniform The lobules consist of very small and medium sized follicles which are rather empty or contain an exceedingly pale-staining colloid. They are lined by rather high, apparently actively secreting, cuboid epithelial cells which, however, show no proliferation and form no papillary excrescences. The interstitia between the follicles are greatly distended by what seems to be inflammatory infiltration with lymphocytes and histiocytes. This, in many places takes the shape of round or elongated lymphoid infiltrates which are quite large and resemble lymph follicles. These infiltrates frequently contain secondary centers. There is no appreciable increase in connective tissue. There is no evidence of neoplastic changes. Many follicles contain clusters of macrophages and no, or only traces of, colloid." (Fig. 2.) The diagnosis was Hashimoto's disease of the thyroid.

The postoperative course was uneventful. The patient was discharged on the seventh postoperative day. Surgical results have been satisfactory in the follow-up period. Basal metabolic readings, repeated at monthly intervals, have not fallen below minus twelve.

Table II

CLINICAL DIFFERENTIAL DIAGNOSTIC FEATURES OF HASHIMOTO'S, RIEDEL'S AND DE QUERVAIN'S THYROIDITIS

	Struma Lymphomatosa	Riedel's Struma	de Quervain's Struma
Age (yr.)	40–60	20–49	20–40
Sex (women)	Almost 100%	60–80%	20–40%
Principal symptoms	Presence of a goiter, vague pressure symptoms	Predominant pressure symptoms	Moderate pressure symptoms, stabbing pain referred to neck, shoulder or ear
Duration of symptoms	Months, with recent acceleration	1–2 yr.	1–12 mo.
Duration of goiter	Years	1–2 yr.	1–12 mo.
Degree of thyroid involvement	Always diffuse	30% unilateral	30% unilateral
Response to x-ray	Usually good	None	Unknown
Postoperative complications	Myxedema, general metabolic disorders	No myxedema, no relief from pressure symptoms	Prompt remission with recurrence of symptoms
Postoperative course	Uneventful	Stormy	Usually uneventful

Case II. (No. 19620.) Mrs. M. E. S., a thirty-five year old white woman (para II, gravida II), was admitted October 18, 1951, with the chief complaints of nervousness for the previous three years, extreme the last three months, and the presence of an enlarging goiter.

The patient stated that for the past four years she had become increasingly nervous and had had frequent emotional episodes. About a year before admission she noticed a hard, smooth swelling in her neck which was growing in size and had become a source of constant worry. While attempting to sleep she had experienced a sensation of choking and smothering. Each morning she awakened with a feeling of weakness bordering on exhaustion. She had little appetite. Occasionally she felt a stabbing pain which radiated upward from the angles of the jaw into the ears. There had been no weight loss, tremor, hoarseness, dysphagia, palpitation or heat intolerance. A bilateral salpingo-oophorectomy and subtotal hysterectomy had been performed for a pelvic inflammatory disease in 1948.

Physical examination revealed a well developed, well nourished white female who did not appear acutely ill. Her blood pressure was 100/68, pulse 72 and respirations 16. The skin was warm and dry. The thyroid presented a hard, smooth, resilient enlargement of the isthmus and both lateral lobes. It could be readily moved and was therefore not attached to the extrathyroid structures. No tenderness or nodules were present. No exophthalmos or tremor was detected and no cervical nodes were palpable.

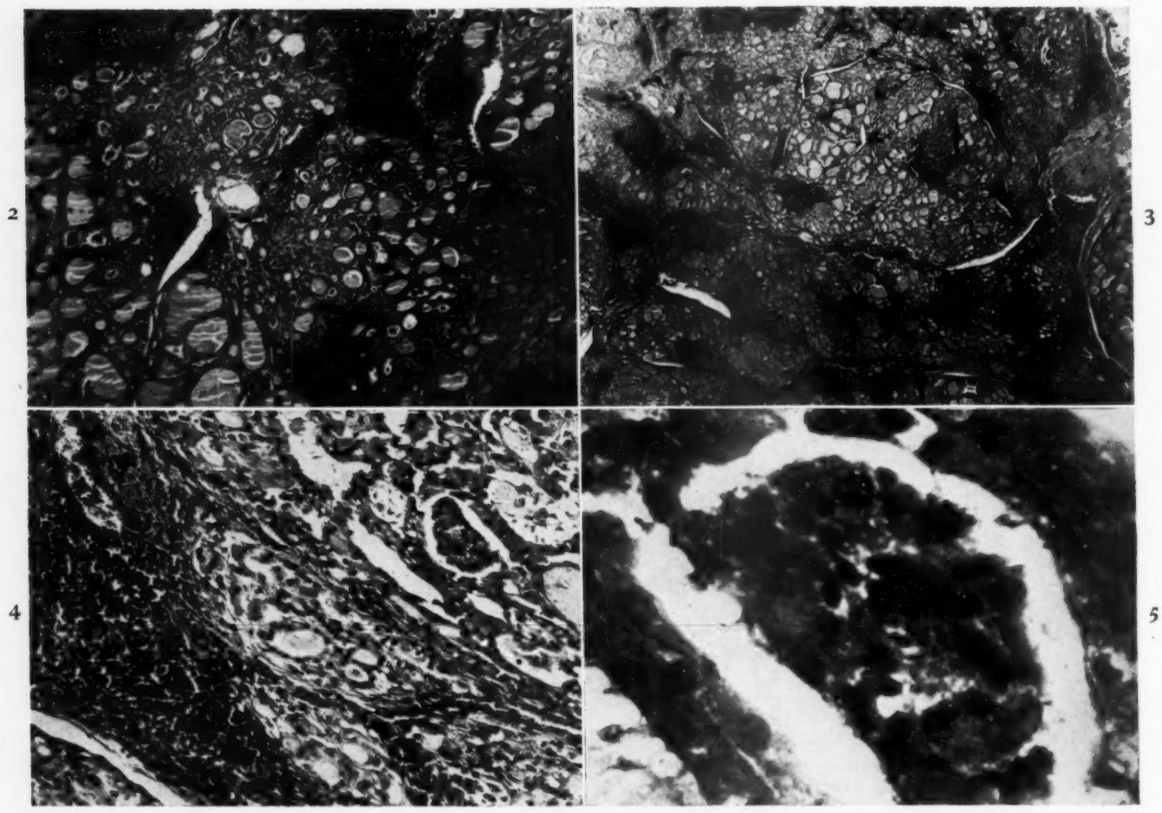

FIG. 2. Case I. Photomicrograph, medium power. Note lymphocytic infiltrates, marked variation in size of follicles; varying but generally poor colloid contents. Many follicles contain clusters of macrophages.

FIG. 3. Case II. Photomicrograph, low power. Note scattered lymph follicle-like structures.

FIG. 4. Case II. Photomicrograph, medium power. Note follicle containing a large cluster of macrophages but no colloid in upper right corner.

FIG. 5. Case II. Photomicrograph, high power. Follicle of Figure 4 containing no colloid but cluster of macrophages with occasional epithelial cells.

The laboratory data were as follows: basal metabolic rate, −12; red blood cells, 4,200,000; hemoglobin, 12.5 gm; white blood cells, 5,950; differential count normal except for 3 per cent eosinophils; Kline test, negative.

The preoperative diagnosis was Hashimoto's disease. Surgery was indicated because of pressure symptoms and for cosmetic reasons. There was no preoperative preparation.

At operation a general anesthetic was administered, using sodium pentothal combined with endotracheal cyclopropane. A subtotal thyroidectomy was performed and 35 gm. of tissue were removed.

The pathologic report was as follows: "The most remarkable feature is the presence of a large number of lymph follicle-like structures, frequently confluent throughout the interstitia of the thyroid gland. The individual lobules are well preserved and consist of follicles filled with pale-staining colloid and lined with fairly high cuboid epithelium. There are also present numerous small follicles which are empty or almost empty. Many of these contain clusters of macrophages. Increase in connective tissue is negligible. Occasionally cystic follicles are found filled with poorly staining colloid. This pathologic structure is uniform throughout the entire thyroid gland." (Figs. 3 to 5.) The diagnosis was struma lymphomatosa (Hashimoto's disease).

The immediate postoperative course was uneventful and the patient was dismissed on the seventh postoperative day. When last seen the patient felt entirely well. Subsequent basal metabolisms taken at monthly intervals have not fallen below minus seventeen.

CASE III. (No. 20053.) Mrs. M. A. M., a thirty-three year old white woman (para VIII, gravida VIII), was admitted October 31, 1951,

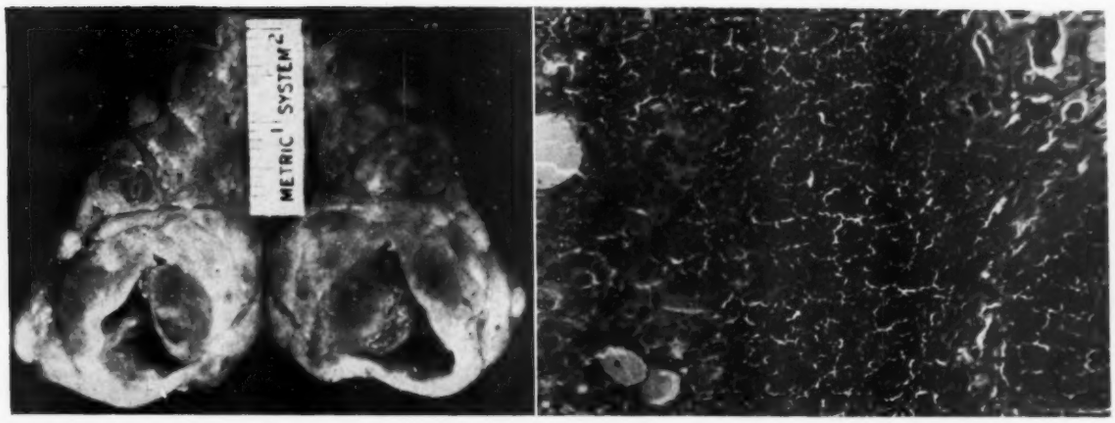

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FIG. 6. Case III. Gross appearance of one thyroid lobe. Note dryness of cut surface suggesting poor colloid contents, and compensatory hyperplasia of an adenomatous nodule in lower pole.

FIG. 7. Case III. Photomicrograph, medium power. Large lymphocytic infiltrates replacing follicles. Note atrophy and disintegration of remaining follicles. Note clusters of macrophages in follicles in upper right corner.

with the chief complaint of rapid enlargement of the thyroid gland.

About eight months before, the patient noticed a "lump" in her neck which occurred shortly before the termination of her last gestation. Enlargement was rapid and she complained of palpitation and nervousness but denied that she had a tremor. She had had no weight loss, dysphagia or hoarseness. She had had multiple pregnancies but no previous operations.

Physical examination revealed an adult white female in an excellent state of nutrition and in apparent good health. Her blood pressure was 118/76, pulse 74 and respirations 18. The skin over both upper and lower extremities was warm and dry. The thyroid was diffusely and bilaterally enlarged. It was not tender and was freely movable in the surrounding tissues. No nodules were palpated and no cervical adenopathy was present.

The laboratory data were as follows: basal metabolic rate, −12; red blood cells, 4,100,000; hemoglobin, 12.2 gm.; white blood cells, 8,000; differential, normal; Kline test, negative.

The preoperative diagnosis was Hashimoto's disease. Surgery was indicated because of pressure symptoms and an unsightly bulge in the neck. There was no preoperative preparation.

At operation a subtotal thyroidectomy was performed under general intravenous sodium pentothal and gas endotracheal anesthesia. Approximately 10 gm. of tissue were removed. One lobe contained a well encapsulated grayish nodule measuring 1.2 cm. (Fig. 6.)

The pathologic report was as follows: "The lobulated structure of the thyroid gland is well preserved but the individual lobules show considerable variation in size. The most outspoken change is that of a diffuse and focal infiltration with lymphocytes and plasma cells, a process which is associated with disintegration of thyroid follicles and their replacement by lymphoid cells. Preceding this disintegration, the follicles are found to be very small, their lumens are empty and contain little colloid and the surrounding epithelial cells are large and cuboid. Many of these follicles contain macrophages in clusters, as well as desquamated epithelial cells. Eventually the disintegrating follicles and lymphoid cells are replaced by young connective tissue. As an apparently compensatory process, adjoining lobules are found within which lymphoid infiltration is negligible and the follicles of which are markedly enlarged and lined with hyperplastic cylindrical epithelium showing a tendency to form papillary projections into the lumen. Lobules consisting of such follicles are found in various sizes and as they are fairly large, seem to represent small adenomas. A nodule found in the right lower lobe shows exactly the same structure of hyperplastic thyroid tissue." (Fig. 7.) The diagnosis was struma lymphomatosa (Hashimoto's disease) with compensatory adenomatous hyperplasia.

SUMMARY

1. Three cases of Hashimoto's disease occurring in full sisters, residing in a non-goitrous region, have been reviewed.

2. An average age for this unusual series was thirty-one years.

3. Hashimoto's disease was correctly diagnosed preoperatively in two of the three cases reported.

4. The present trend in the treatment of Hashimoto's disease is toward subtotal thyroidectomy and away from x-ray therapy.

5. The accurate diagnosis of Hashimoto's disease rests largely on the exercise of a high index clinical suspicion.

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RETROPERITONEAL RUPTURE OF THE DUODENUM IN NON-PENETRATING ABDOMINAL TRAUMA*

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ANY traumatic condition that still commands a mortality of 20 to 50 per cent when proper treatment is known to reduce this to practically zero demands further attention. The frequent mismanagement of a condition whose proper treatment is fairly simple is cause for further concern. Retroperitoneal rupture of the duodenum due to a non-penetrating wound of the abdomen is such an injury. Although much has been written about it since the collection of twenty-four cases by Schumacher in 1910, the mortality and morbidity have not been satisfactorily reduced. A recent experience has stimulated us to review the literature pertinent to retroperitoneal rupture of the duodenum.

CASE REPORT

J. O. B. (No. 204942), a twenty-seven year old Negro was admitted to the hospital on April 15, 1951. The patient was thrown against the steering wheel of an automobile in an accident four hours prior to admission. He was momentarily unconscious but was able to walk away from the accident. He vomited shortly afterwards. The patient had been drinking excessively and the role of alcohol in the vomiting and absence of pain could not be evaluated. He took another drink after the accident and vomited again. About one hour later he first noted pain, which became progressively worse. There was no further vomiting, no diarrhea or unusual desire to void. The pain was described as sharp, boring, steady, severe and located almost entirely on the right side. There was no radiation. The remainder of the history was non-contributory. Physical examination revealed the blood pressure to be 130/65, pulse 90, respiration 28 and temperature (rectal) 100°F. Examination revealed patient holding his abdomen and moving about constantly in an attempt to find comfort, which was obtained only in lateral hyperflexion. Examination of the abdomen revealed no external evidence of trauma, some slight lower abdominal distention, no visible masses or peristalsis. Peristaltic activity was diminished over the entire right side, with board-like rigidity. The left side was essentially normal. There was no costovertebral angle tenderness. Rectal examination was negative.

Impressions were (1) ruptured viscus; (2) pancreatic injury; (3) abdominal wall hematoma. Scout film of the abdomen revealed a "left ileo-psoas shadow which was well visualized while the right ileo-psoas shadow was not visualized. There was no evidence of free air in the peritoneal cavity." Exploratory laparotomy was performed two hours after the patient was first seen. An extensive subserosal hematoma of the proximal portion of the transverse colon was noted. No free air or fluid was found in the peritoneum, and no fecal odor had been detected on opening the peritoneum. Thorough exploration revealed nothing in the peritoneal cavity other than the previously mentioned hematoma of the transverse colon. However, on the posterior parietal peritoneal surface just above the upper pole of the right kidney there was a bluish black discoloration that extended up to the gastrohepatic ligament retroperitoneally and from the midline to the lateral margin of the kidney. This was thought to represent hemorrhage from a lacerated kidney, and the peritoneum was incised to uncover this area. The tissues were infiltrated with clear, brownish green fluid which seemed to have extravasated into all the retroperitoneal tissues. The kidney cortex was intact. Dissection towards the duodenum revealed a perforation of the postero-inferior surface of the duodenum just as it crossed the spine. There was a free flow of bile coming from this area as soon as it was exposed. Further mobilization of

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the duodenum with upward and medial rotation revealed the perforation to be 2 to 3 cm. in length. It was closed transversely. A drain was placed near but not adjacent to the repaired perforation and brought out through a stab wound. The duodenum and pancreas were

TABLE I

Author	Year	Cases	Mortality	
Schumacher	1910	24	91.7	From Lauritzen [17]
Guibé	1910	26	92.3	
Miller and Schumacher	1916	46	89.1	
Soderlund	1918	37	86.5	
Hinton and Guibe	1940	85	68.2	
Johnson, Miller, Schumacher	1943	98	68.3	
Hinton	1940	59	57.6	
Johnson	1943	52	50.0	
Cohn	1952	25	20.0	

further explored, but no further lesion was found. Because of the soilage from the perforation a drain was placed at the head of the pancreas and brought out through the stab wound. The operation was then terminated with the patient in excellent condition.

Postoperatively he was placed on continuous nasogastric suction, intravenous fluids, penicillin and streptomycin. On the first postoperative day the abdomen was soft and flat, without audible peristalsis and with no drainage on the dressings. Wangensteen drainage for the first three days was 530, 980 and 700 cc., and after this the tube was clamped on alternate hours and removed on the subsequent day. On the fourth postoperative day oral liquids were started and were well tolerated. On the eighth postoperative day drains were removed without any further trouble. The incision was healed by this time and the patient was tolerating a soft diet. The van den Bergh test showed a slight elevation (to 0.8) on the third postoperative day which was thought to be due to: (1) absorption of bile from the retroperitoneal tissues; (2) some edema about bile ducts; and (3) normal postoperative elevation in patients receiving transfusions. It returned to normal by the eighth postoperative day. The patient was detained to secure postoperative x-rays which were done on May 1, 1951, and noted elsewhere in this article. He was discharged the next day on a full diet. Subsequent clinic visits revealed no sequalae as recently as February, 1952.

In 1910 Schumacher[25] reviewed ninety-one cases of duodenal rupture due to non-penetrating abdominal injuries of which twenty-four were retroperitoneal. Of this latter group only 7 per cent survived, to give a mortality of 93 per cent. (Subsequent reviews are listed in Table I. Johnson[14] reported a 50 per cent mortality as late as 1943.) The case mortality rate has been decreasing as shown in Table I, but even the cases reported since Johnson's review show a mortality of 20 per cent, as seen in Table II; and since we can be fairly certain that a number of fatal cases have not been reported, the actual mortality probably is even higher.

INCIDENCE

Rowlands[23] collected 381 cases of intestinal rupture due to non-penetrating injuries of which only twenty-three were duodenal rupture. Siler[26] quotes a review of 1,183 cases of subcutaneous rupture of the intestines with 113 in the duodenum. Miller[20] and Sarnoff[24] have estimated that 10 per cent of all gastrointestinal tract ruptures were duodenal, while Kellog[15] estimated 16.5 per cent.

Schumacher[25] stated that 25 per cent of the duodenal ruptures were retroperitoneal, and Jacobs et al.[12] stated that over 90 per cent of these were in the second and third portions of the duodenum. Maingot[19] believed that only 25 per cent were in the third portion. The sites of tears as tabulated by Guibé[10] and by Kellog[15] are listed in Table III.

Kellog[15] and Maingot[19] found the injury eight times more frequent in men. We believe this may be related to the more frequent occurrence of severe abdominal trauma in the male. Two of the twenty-five cases reported here were in women.

CAUSES

Intra-abdominal disorder due to non-penetrating trauma is usually caused by some severe physical force, but all writers have commented on the minimal force that occasionally causes this injury. Usual causes include sudden, unexpected crushing injury of some kind; a severe blow to the abdomen; a kick; crush by a vehicle; injury while riding in an automobile, particularly by the steering wheel; and occasionally by a rather severe blow to the back. Ficarra[9] points out that with a sudden, unex-

TABLE II

Author and Year	Age and Sex	Type of Injury	Symptoms and Signs	Time Injury to:		Lesion	Location	Operation	Result
				Hospital	Operation				
Dixon, 1941.....	57,M	Crush	Unconscious 1 hr; vomited once; increased abdominal rigidity	7 hr.	Over 24 hr.	Perforated	3rd portion	Closed	Eviscerated 3rd day; died with bronchopneumonia 6 days postoperatively
Somogyi, 1941....	48,M	No injury	Ulcer history, 5 yrs; severe vomiting 3 days	.....	Day of admission	No diagnosis	.....	Gastroenterostomy; drainage retroperitoneal abscess	Died; retroperitoneal perforation; duodenal ulcer; retroperitoneal phlegmon; pulmonary edema
Leidberg, 1942....	37,M	Crush, steelplate	Vague abdominal pain; abdominal rigidity	1½ hr.	4 hr.	Perforated	Posterior	Closed; drained	Recovered; duodenal fistula; obstruction requiring gastrosterostomy
Leidberg, 1942....	53,M	Kicked by horse	Severe abdominal pain; rigidity	6 hr.	Immediate	Perforated	Posterior, right side	Closed	Died; acute diffuse peritonitis; retroperitoneal emphysema; acute parenchymatous heart degeneration
Struppler, 1942...	18,M	Kicked by horse	Pain	.....	.....	Retroperitoneal emphysema and bile infiltration	.....	Sutured, Bilroth II gastrectomy	Recovered
Struppler, 1942...	50,M	Kicked by horse	Pain	.....	.....	Previous gastrectomy for ulcer	.....	Repaired, drained	Recovered pneumonia; fistula to transverse colon closed spontaneously 8 wk.
Jacobs, 1944.....	50,M	Pushed against car	Slight back pain; vomiting; distention; later temperature, pulse and respiration up; rigidity	Overnight	None	Perforation	3rd portion, anterior wall	None	Died 6th day; retroperitoneal phlegmon
Jacobs, 1944.....	46,M	Crush-fall	Cerebral concussion	.....	None	Retroperitoneal rupture duodenum from x-ray diagnosis	.....	None	Recovered; conservative treatment
Trafford, 1944....	50,M	Thrown against car	Vomiting, pain, rigidity later; silent abdomen later	Over 24 hr.	On admission	1 inch rent in duodenum	2d portion posterior	Closed, drained	Died 1 wk.; bronchopneumonia; retroperitoneal cellulitis; no peritonitis
Koenig, 1947.....	60,F	None	Pain, nausea, vomiting; epigastric distention; right upper quadrant tenderness	2 days	22 days	Divertic by x-ray; subphrenic abscess	1st portion posterior	Drained, abscess	Recovered
Lauritzen, 1947...	22,M	Knee in abdomen	Pain, vomiting	2½ hr.	4 hr.	Rupture	4 cm. from angle, posterior wall	Repaired, drained	Recovered
Patkay, 1947.....	....	.....	.....	.....	.....	Rupture	Below pylorus	Resected	Recovered
						Rupture	Below pylorus	Resected	Recovered
Siler, 1949.....	13,M	Fall on back	Pain, later vomiting, shock, distention, right lower quadrant tenderness; toxemia	Over 24 hr.	8 hr. after admission	Normal appendix; retroperitoneal fluid; x-rays 1 wk. later showed duodenal fistula	.....	Drained retroperitoneal area; reoperated 11 days after injury; rent repaired	Recovery after stormy course

TABLE II (*Continued*)

Author and Year	Age and Sex	Type of Injury	Symptoms and Signs	Time Injury to:		Lesion	Location	Operation	Result
				Hospital	Operation				
Siler, 1949.....	12,M	Crush	Symptoms of ruptured viscus	2 hr.	Several hr. later	Laceration	Junction 2nd and 3rd portions	Repaired, drained	Recovered
Siler, 1949.....	49,M	Fall	Mass right lower quadrant	5 mo.	33 days after admission	Abscess, laceration duodenum	2nd and 3rd portion	Repaired, drained	Recovered
Siler, 1949.....	30,M	Auto steering wheel	Tenderness right upper quadrant; rigidity; no peristalsis	1 hr.	11 days	Transverse tear	Junction 2nd and 3rd portions	Repaired, drained	Recovered
Spohn, 1949.....	18,M	Hit in abdomen	Shock; pain, right side	Immediate	1¼ hr.	Perforated 1 cm.	2nd portion	Peritoneum sewn over defect; gastroenterostomy; pylorus closed	Recovered
Aladjem, 1950....	11,M	Fall from bike	Nausea, vomiting, abdominal pain; rigidity and tenderness later	6 hr.	Immediate	Laceration	2nd portion	Repaired, drained	Recovered
Aladjem, 1950....	32,M	Crush, steering wheel	Rigidity, tenderness; fractured tibia, foot, cranium; shock	2 hr.	Immediate	Laceration	2nd portion	Repaired, gastroenterostomy	Recovered
Aladjem, 1950....	34,M	Hit in abdomen	Shock; rigidity; pelvic fracture	6 hr.	Immediate	Rupture	2nd portion	Repaired	Recovered
Aladjem, 1950....	36,M	Fall up stairs	Urinary retention; catheterized; blood in urine	4 hr.	Immediate	Rupture; lacerated kidney	2nd portion; duodenojejunal angle	Repaired both perforations; sutured kidney	Recovered
Simpson, 1950....	15,F	Fall	Abdominal pain, tenderness, rebound; no peristalsis; tympanitic	6 hr.	Immediate	Rent	Posterior wall, 1st and 2nd portions	Transected pylorus, closed; stomach anastomosed end-to-side to jejunum; drained	Recovered
Newell, 1951.....	20,M	Auto accident	Spasm. Right upper quadrant pain, questionable mass; right mid-clavicular line; no peristalsis; tympanitic	12 hr.	14 hr.	Tear, transverse	2nd portion posterior	Repaired, drained	Recovered after duodenal fistula developed and closed
Cohn, 1952.....	27,M	Crush, steering wheel	Abdominal pain, tenderness, rigidity	4 hr.	6 hr.	Perforated	Posterior wall, 3rd portion	Repaired, drained	Recovered

pected blow the abdominal muscles are relaxed and therefore the full force can be transmitted to the duodenum.

The duodenum is thought to be well protected by its location in the abdomen; but where it crosses the spine, it is more vulnerable to a crushing injury. In the course of a blast injury, either in air or water, the duodenum is as vulnerable as all other viscera. Duodenal rupture may be sustained when the pylorus is closed and the duodenojejunal angles acutely flexed, making the duodenum an air-trap.

TABLE III

Location	Guibé[10]		Kellog[15]	
	No.	Per cent	No.	Per cent
Region of pylorus	7	6.4	9	6.1
First portion	16	14.6	21	14.1
Second portion	20	18.4	3	2.0
Junction 2 and 3	8	7.3	1	0.7
Third portion	22	20.2	29	19.5
Fourth portion	4	3.7	...	.....
Area of duodenojejunal angle	32	29.4	23	15.4
Superior angle	...	.....	3	2.0
Inferior angle	...	.....	15	10.0
First and second portion	...	.....	1	0.7
Superior and inferior angles	...	.....	1	0.7
Not specified	...	.....	43	28.8
Total	109	100	149	100

Trauma to the abdominal wall frequently leaves no signs, and the search for local bruises, hematomas or laceration may be unrewarding.

ASSOCIATED INJURY

At the time of the abdominal trauma there may be any other injury, the more commonly mentioned being cranial injury, fractures of the extremities and multiple rib fractures. However, associated intra-abdominal lesions cause most difficulty, acting in two ways: (1) they may be overlooked; (2) they may so attract attention that the duodenal lesion will be completely missed with eventual fatal outcome.

The most commonly associated lesions in the abdomen are lacerations of the liver, spleen, kidney and pancreas; rupture of the stomach, small or large intestine in other locations; lacerations of the omentum; rupture of the bile ducts or gallbladder; injury to the portal vein or ureters; and finally, the possibility of additional areas of rupture in the duodenum itself.

DIAGNOSIS

The diagnosis can almost be made from the history, with the addition of just a few of the signs or symptoms to be noted below. Immediately following the injury the patient is frequently unconscious for a few minutes. Following this there is usually complete recovery, and the patient may return to his work or he may go home because of some vague discomfort. Several hours later there may be one or two episodes of vomiting, although nausea and vomiting may be completely absent. The vomitus may contain blood, but this is not a universal finding. Then abdominal pain begins and progressively increases in severity. It is a steady, severe, incapacitating pain which usually causes the patient to seek a doctor. The pain-free interval may be explained by the fact that after the initial blow some time must elapse to allow a sufficient quantity of duodenal contents to get into the retroperitoneal tissues to cause pain by irritation of the tissues or by distention of the peritoneum. The duration of the quiescent phase probably depends on the size of the tear, the secretory activity at the time of the rupture, the contents of the stomach at the time of the injury and the amount of ileus produced by the blow itself. Bockus[3] compares the clinical picture to that of a perforation of a posterior wall ulcer.

Shock may be present, or imminent. In either case it is due to the original trauma and/or the pain from the leak, as there was not enough blood loss to account for shock in any reported case of isolated retroperitoneal rupture of the duodenum. *Pain* may be severe. It may be localized to the right upper quadrant, to the right side of the back or generalized in the back and sides. *Tenderness* will usually follow the course of the pain, and as time progresses there will be some rigidity of the right side, particularly of the upper quadrant, but the extent and severity of the rigidity varies greatly. Rigidity is not a dependable sign. *Vomiting* will become more severe with the passage of time, but this symptom is not to be depended on in the early stages and it should not be awaited. *Hemorrhage* if present is usually due to an associated lesion. *Distention* may be present, but is usually not severe. *Peristalsis* may be absent or greatly reduced. *Temperature*,

pulse and respiration may show very minimal changes at first, but with the passage of time each will rise. White count will show a slight elevation with a progressive increase in the polymorphonuclears. Testicular pain and priapism have been reported. Butler and Carlson[4] attribute this to "irritation of testicular nerves, the sympathetic chain accompanying the spermatic artery" from bile in retroperitoneal tissues.

X-RAY FINDINGS

X-ray evidence on preliminary scout film of retroperitoneal rupture of the duodenum is of the utmost help *when present*. But, in our case, and in all but six of the reported cases, x-rays were negative. Therefore one cannot await x-ray evidence of a perforation before proceeding with surgical therapy. Jacobs, Culver, and Koenig[12] emphasize that "the use of barium or bismuth salts in the roentgen diagnosis of any acute perforation of the gastrointestinal tract is contraindicated." Barium in the tissue may act as a foreign body irritant and may serve to enlarge the retroperitoneal area of infiltration further. The procedure may be shocking to a patient who is already on the verge of shock. However, Siler[26] recommends the use of barium and Koenig and Culver[16] used it to aid in making the diagnosis in a subsequent case report. We believe barium demonstration of the perforation should not be attempted if the scout film is negative. Jacobs et al.[12] point out that since 90 per cent of the perforations are in the second or third portions of the duodenum, the air pattern should be constant. The diagnosis will therefore depend on infiltration of the retroperitoneal tissues with free air, which does not move when the patient changes position. Air may be present in very small quantity, or there may be extensive dissection of the air throughout all the retroperitoneal tissues. The importance of examining the patient in several positions has been stressed.[12] Jacobson and Carter[13] have classified the findings as follows: (1) Air may outline the kidney, or extend along the vertebral column and the crus of the diaphragm; (2) the renal and psoas shadows may be obliterated; or (3) there may be no abnormality. We believe the most important feature about x-ray diagnosis is that one cannot await a positive diagnosis or, as stated by one of the roentgenologists,[13] "marked paucity of positive findings makes the roentgen examination of the abdomen of little value in excluding perforation of small intestines following nonpenetrating abdominal injuries."

TREATMENT

Since the early signs of this type of injury are minimal, it has been suggested that " . . . all severe non-penetrating abdominal injuries should be hospitalized for at least twenty-four hours and that during this period x-ray studies of the abdomen and careful evaluation of clinical and laboratory aspects of the case be undertaken . . . Being conscious of the dangers inherent in the non-penetrating abdominal injuries will add to our efficiency . . . "[5] That the treatment has not always been ideal is attested by noting the course of previously reported cases in Table 1. The high mortality figures are another sign of improper therapy, but perhaps an even greater indictment is seen in the large number of these patients who have been operated upon without the true nature of the lesion being found. This condition is improving since the lesion was overlooked at surgery in seven cases from 1916 to 1943, and only overlooked in two cases in the present series. Another indication of improper therapy is the frequently prolonged delay from the time of hospital admission until operation. If a patient is admitted in shock, naturally time must be spent correcting this before surgery can be undertaken; but outside of the few hours that may be necessary to correct shock and/or electrolyte imbalance, further delay cannot be condoned.

Once the diagnosis is established, or even suspected, the patient should be immediately prepared for surgery. Blood and/or plasma should be given as indicated. If vomiting has been of major proportions, fluids should be replaced rapidly and electrolyte imbalance corrected. A tube should be placed in the stomach and continuous suction applied. A *thorough* exploration should be done, remembering that there *may be no intraperitoneal signs* of retroperitoneal rupture, and further that multiple lesions are often present. The presence of free fluid in the peritoneum has been noted by a number of authors, although no free fluid was present in our case. Johnson[14], Dixon[7] and Lauritzen[17] noted straw-colored fluid in the peritoneum; Simpson[27] noted a small amount of free blood; Newell[21] noted brownish fluid;

Kellog[15] mentioned that there was regularly a quantity of dark blood-stained fluid not usually offensive in odor, with or without peritonitis; and Trafford[31] noted a mild, fibrinous peritonitis in the right upper quadrant, although this is certainly at variance with the general findings. Another feature that should force further careful exploration is hematoma formation or bile extravasation in the retroperitoneal tissues. This may be in a fairly localized area just below or lateral to the duodenum, or it may be quite widespread along the posterior peritoneal wall, depending on the time interval and the size of the perforation. Crepitation may also be present in this area due to the escape of air from the gastrointestinal tract. Hemorrhage or biliary discoloration of the meso of the transverse colon or small bowel should be another source for suspicion.

The following signs have also been reported as indications for further exploration: elevation of the posterior peritoneum with a glassy edema; petechia or fat necrosis over ascending and transverse colon or meso; retroperitoneal phlegmon; hematoma over the head of the pancreas extending into the base of the mesocolon; fat necrosis of retroperitoneal tissues; discoloration of retroperitoneal tissues either dark due to hemorrhage, grayish due to suppuration or yellow from bile.

If any of these findings suggest that the duodenum should be explored, the remainder of the abdominal exploration should be carried out and any other intraperitoneal problems attended to first. Then the duodenum should be mobilized by incising the peritoneum along the lateral, avascular border of the duodenum and rotating it medially. If necessary the gastrocolic omentum and the transverse mesocolon can be incised to allow further exploration of the duodenum, but this should rarely be necessary. Welch[32] suggests identification of the common duct if the region of the ampulla is involved since reimplantation of the duct may be necessary. In our case the site of rupture was found by following the bile to its point of maximum concentration once the duodenum had been mobilized.

The local treatment of the perforation itself will depend more on the size of the perforation than any one other single factor. If it is at all possible to close the perforation without materially decreasing the lumen of the duodenum, then this should be done. However, if the perforation is so large that closure will stricture the duodenum, consideration can be given to: (1) complete division of the duodenum and an end-to-end anastomosis; or (2) division of the duodenum, closure and gastroenterostomy, as has been necessary in some cases of complete transverse tears of the duodenum. Lauritzen[17] points out that if a resection is necessary it probably should not be done more than twelve hours after the injury has been sustained. We favor closure with absorbable sutures using a Connell type inner layer and then an outer layer of interrupted mattress sutures of a non-absorbable suture. After closure the duodenum should be carefully palpated to exclude stenosis.

The most important step besides closure is drainage of the retroperitoneal area. The drains should be brought down to the duodenal area, but should not come in actual contact with the repaired perforation because of the danger of fistula formation. The drains should be brought out through a stab wound rather than through the incision. They should be left in place until feeding has been started and drainage of all kinds has ceased.

Postoperatively, antibiotics, parenteral fluids, continuous gastric suction and withholding of oral intake should be continued until there is evidence of good peristaltic activity and satisfactory closure of the perforation seems assured. Then oral intake should be slowly and cautiously resumed, perhaps with the suction still being used intermittently, and gradually increased as tolerated.

Because of the comparative rarity of this lesion and because of the possible stenosis that can result from the closure of the perforation, we believe that these patients should be x-rayed before they are discharged and adequate visualization of the area of perforation should be obtained. In our case x-rays two weeks postoperatively showed " . . . minimal transient dilatation at the third portion (of the duodenum) associated with a slight prominence of the mucosal folds in this region, probably the result of postoperative edema. The loop is otherwise negative, there being no evidence of constriction." (Fig. 1.)

COMPLICATIONS

Short of a failure to find the lesion at surgery and resulting fatality, there are a number of complications that may result from this injury. To mention them briefly they include: external

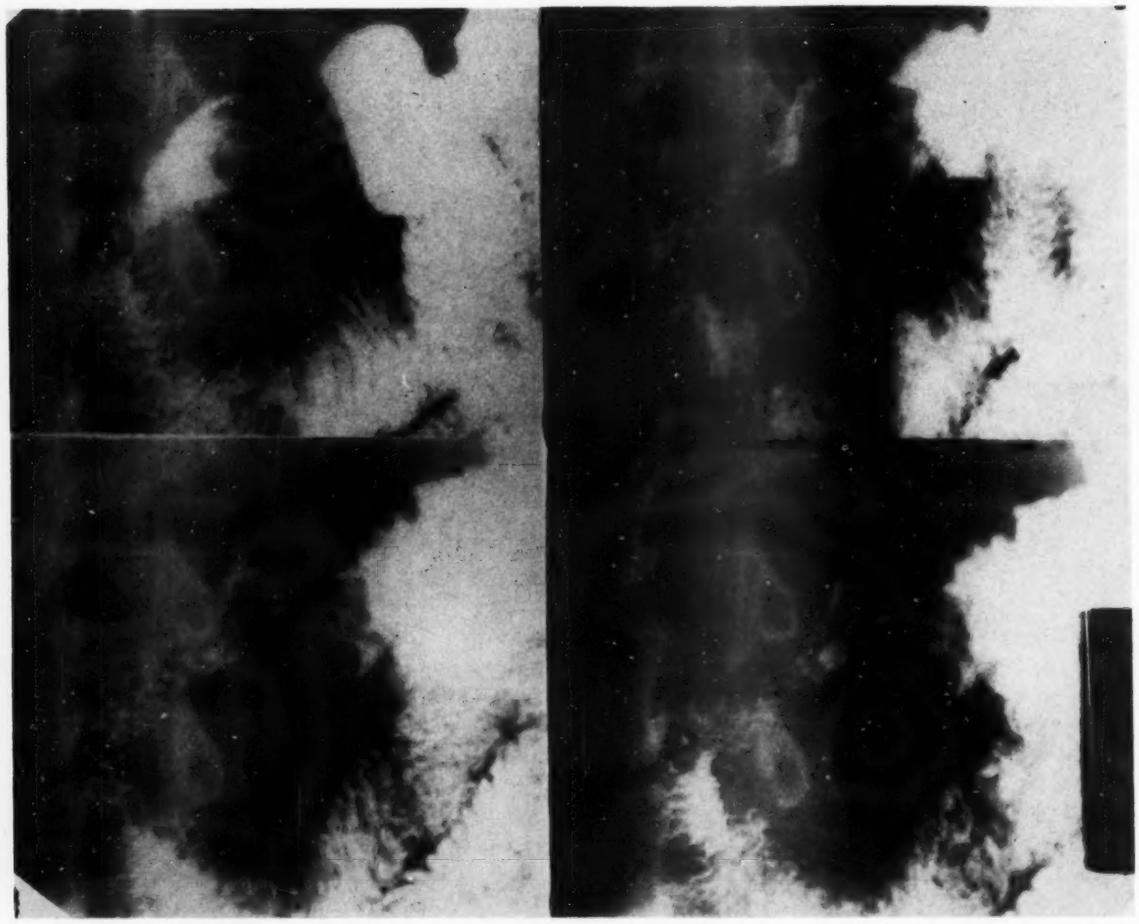

FIG. 1. Serialgram of the duodenum two weeks postoperatively showing essentially normal duodenum and absence of constriction.

duodenal fistula, retroperitoneal cellulitis, peritonitis, local abscess, subhepatic or subphrenic abscess, fistula to colon or pancreas, stenosis of duodenum or bile ducts, pulmonary infection, and, of course, wound infections. If the patient is seen early enough and properly treated, most of these should be avoided.

CONCLUSIONS

1. The mortality of retroperitoneal rupture of the duodenum due to non-penetrating abdominal trauma is still too high.
2. Retroperitoneal rupture of the duodenum should be suspected in any severe abdominal trauma with a symptom-free interval followed with shock or signs of intra-abdominal disorder.
3. The presence of other lesions, either intra-abdominal or elsewhere, does not exclude retroperitoneal rupture of the duodenum.
4. Diagnosis can frequently be based on history alone.
5. X-ray diagnosis is not dependable. It is helpful only when positive.
6. An immediate, thorough exploration should be done in all suspected cases, remembering that there may be no intraperitoneal signs even at surgery.
7. A primary repair should be done using whatever technic is most suitable.
8. The retroperitoneal area should be adequately drained.
9. Early diagnosis and proper treatment of retroperitoneal rupture of the duodenum should result in a significant lowering of the mortality from this condition.

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SURGICAL CONSIDERATIONS IN REMOVAL OF RENAL AND URETERAL CALCULI*

WITH SPECIAL EMPHASIS ON REMOVAL OF STAGHORN CALCULI

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THE time may come when some method will be found to dissolve calculi within the kidney thereby rendering surgical removal unnecessary. Until that time, however, the problem of removing renal calculi, especially of the recurrent and staghorn varieties, will continue to tax the skill and resourcefulness of the urologist.

The advent of chemotherapy and the antibiotics has emboldened the present day urologist to employ certain procedures which were tried years ago and discarded. In view of the present widespread use of extensive nephrotomy in cases of staghorn calculosis it appears timely to re-emphasize some of the undesirable aspects of this operation and at the same time to present certain experiences with more conservative maneuvers that have yielded more satisfactory results. Surgical removal of calculi from the kidney, prevention of recurrence of stones and the treatment of ureteral calculi will be discussed.

Although refinements in diagnosis, improvements in anesthesia and more precise surgical technic have been responsible for the increasingly satisfactory results, the high incidence of recurrence of renal calculi and their sequelae indicate the difficulties inherent in the treatment of this condition.

SURGICAL TECHNIC OF REMOVAL OF CALCULI FROM THE KIDNEY

The position of the patient on the table is important; it should be such as to enlarge the space between the lowermost rib and the iliac crest.

Exposure of the kidney is often rendered difficult by too short an incision. The length of incision is determined by the size of the patient and the position of the kidney. An incision beginning at the costovertebral angle, following the course of the last rib and extending to the downward prolongation of the anterior axillary line provides an adequate view of the renal fossa and facilitates mobilization of the kidney. If the kidney has been operated upon previously, division of the twelfth rib or its removal subperiosteally will facilitate exposure. The layers of muscle encountered along the line of incision may be divided down to and including the lumbodorsal fascia without fear of postoperative herniation, provided that proper closure of the wound is accomplished and the lowermost thoracic, ilioinguinal and iliohypogastric nerves are not sacrificed. Gerota's fascia is opened near the costovertebral angle and the edges retracted mesially.

In exposure of the renal pelvis the kidney is mobilized by freeing the upper and lower poles and delivering it into the wound. Strips of gauze are placed around both poles and crisscrossed. These are held by the assistant, thus forming a sling retractor. The pelvis is freed of overlying fat by blunt dissection and its posterior surface is identified at the hilum. If the pelvis cannot be identified readily, the ureter is isolated and traced upward. Occasionally the pelvis must be sought anteriorly. Immobilization of the wall of the pelvis with a guide suture on each side of the incision is advisable. If the extrarenal pelvis is small, exposure is facilitated by elevating the parenchyma with a small, smooth, right-angled retractor.

After incising the pelvis, stones may be removed easily with any of the Randall type of forceps. The latter have angles designed to enter the superior, middle and inferior calyces. Introducing the tip of the gloved finger or even the nail of the ungloved finger often will be helpful in removing a calculus that is imbedded in the mucosa.

Since many so-called recurrences actually represent calcareous fragments that were not removed at operation, the importance of a

* Read before the Pan-American Congress of Urology, Mexico City, Mexico, October 11, 1951.

thorough search for all calculi at the primary operation cannot be overemphasized. A roentgenogram should be taken immediately before the patient enters the operating room and should be compared with a second film taken in the operating room after removal of the calculi. The second film measures 4 by 5 inches, is encased in a sterile muslin envelope and is held against the posterior surface of the organ. A straight needle, with the eye in the kidney, is placed at either the upper or the lower pole for identification. While the film is being developed, thorough lavage of the renal pelvis with physiologic solution of sodium chloride or sterile water, through a soft rubber catheter placed into the pelvis, will flush out many small stones or sandy material. Should the second film reveal the presence of residual calculi, the fibrin-coagulum method of removal introduced by Dees[1] may be employed and a third film then taken. If despite both of the aforementioned measures small calculi still remain in one or more calyces, small nephrotomy incisions may be required. The latter are made over the calculi which are pushed to the surface by the finger in the pelvis.

A large branched calculus or a large stone in a dilated calyx with a strictured isthmus requires nephrolithotomy. In the latter instance forcing the stone to the parenchymal surface with a finger in the pelvis and incising directly over the stone will facilitate its removal. If the pelvis is intrarenal, the site of the incision may be determined by palpating a soft area on the cortex. This soft area usually represents a dilated calyx containing the stone. The area should always be needled before being incised. If stones are situated in the upper and lower calyces, with infection behind the stones, calyciectomy and resection of the upper or lower pole may be required.

In the removal of staghorn calculi one of the chief problems is that of hemostasis. Accordingly, the friability of the renal parenchyma has compelled the urologist to avail himself of several methods to control bleeding, namely, electrocoagulation, transplants of fat or of muscle beneath the extrarenal mattress sutures to prevent cutting through, ribbon catgut, oxycel gauze and gelfoam pads, and finally, digital pressure. If the kidney continues to bleed despite all these measures, the surgeon is faced with the problem of whether or not to perform nephrectomy immediately. Brisk hemorrhage after incising the kidney along Brodl's line has caused many urologists to wonder whether or not such a "line" actually exists. When mattress sutures are employed, it is expected that ischemia and infarction will result; often these infarcted areas undergo aseptic necrosis and primary or delayed secondary hemorrhage may occur necessitating rapid nephrectomy. On completing extensive nephrolithotomy the urologist often is faced with the problem of closing the wound over a bleeding kidney or proceeding with nephrectomy.

I am in agreement with those who maintain that there is no such entity as a silent stone. This term is a misnomer.

Many are thoroughly familiar with the course and end results in cases of bilateral renal calculosis. Nephrolithotomy and nephrostomy on one side usually constitute the primary operation. Subsequently, a similar procedure is followed on the opposite kidney. Nephrectomy on one side or the other for recurrent calculus formation is common. The patient, miserable and forced to wear a nephrostomy apparatus in the single remaining kidney, welcomes death as a merciful release. Needless to say, whenever possible one should operate on the better functioning kidney first.

A more conservative surgical approach obviously is in order in renal calculosis of congenital solitary kidney or of single remaining kidney. I have utilized intrapelvic litholapaxy by means of an incision into the upper part of the ureter. According to Priestley,[2] extensive pole-to-pole incision seldom is necessary and when employed is fraught with danger, especially if infection is present.

Infection behind a calculus, causing ascending pyelonephritis and multiple cortical abscesses, calls for removal of the calculus provided that the kidney is not hopelessly diseased.

The age of the patient may influence the choice between nephrectomy and nephrolithotomy. No one would question nephrectomy for staghorn calculus if the patient is well advanced in years, but in a younger person nephrolithotomy definitely is the procedure to be performed.

Since a great majority of stones are secondary to obstructive uropathies, the incidence of recurrence will be high if the obstruction is not removed at the time of the primary operation. However, this is not true of staghorn calculosis for I frequently have searched for and have

been unable to find any significant obstruction in such cases. Many urologists believe that staghorn calculi occur most frequently in kidneys with intrarenal pelves and that impairment of hydrodynamics plays a major role in stone formation. Infection with a urea-splitting organism also is a contributing factor. Staghorn calculosis is notoriously a recurrent condition and secondary operations in these cases constitute major urologic problems. I have abandoned the traditional approach through the previous scar and now prefer to make a fresh incision posterior to the old scar. This facilitates easier recognition of planes of cleavage and anatomic structures.

My experience with pelviolitholapaxy began in 1946 when I was faced with the problem of removing a staghorn calculus from a young soldier who had a single, badly infected kidney. A small incision was made in the upper part of the ureter. Between two "guide" sutures a curved Kelly clamp was introduced and the stone was grasped and crushed. Surprisingly, the stone split easily into two fragments; each half was removed separately through the opening in the ureter. The same procedure has been employed in several other cases and it has been found that crushing of these stones has been relatively easy compared to litholapaxy for vesical calculi. In the case of calculi in the bladder the instruments must possess powerful crushing jaws. In one case of staghorn calculus which filled the intrarenal pelvis quite snugly, in attempting to apply a curved Kelly clamp to the stone the renal parenchyma ruptured and several mattress sutures were required to control hemorrhage. Should fragmentation occur, lavage of the pelvis will wash away most of the free fragments; if the roentgenogram reveals residual calculi, the fibrin-coagulum method will result in removal of many of the free fragments in the pelvis. The initial roentgenogram should not be relied on for determination of the exact number of stones present since these calculi quite often are superimposed on one another. Fragments of a crushed staghorn calculus which remain trapped in the minor calyces because of constriction of the isthmus require small nephrotomy incisions over the calculi, with the finger in the pelvis pushing the stone toward the surface. It is my opinion that this maneuver could be employed to advantage more often and that it should be tried before extensive pole-to-pole nephrotomy is carried out; however, the latter procedure is necessary from time to time.

It is interesting to note that Slaughter[3] in the seventy cases in which he employed his modified method of extensive nephrotomy kept the renal vessels clamped continuously for a period of one hour. None of the seventy patients required secondary nephrectomy.[4] It had been generally considered that twenty to twenty-five minutes was the safe maximal period of occlusion of the renal vessels. Recent experimental work on dogs indicates that clamps may be applied to the renal pedicle for as long as two hours without incurring irreparable damage. This problem is worthy of further investigation.

After extensive nephrolithotomy and if extensive damage to the kidney has occurred as the result of long-standing obstruction, nephrostomy should be performed. This procedure is indicated especially if infection with Bacillus proteus ammoniae exists. This organism is peculiarly resistant to all of the modern antibiotics. Lavage of the renal pelvis with 0.5 per cent solution of phosphoric acid has been helpful in combating this infection. Polymyxin B and chloromycetin also have been reported as having beneficial effects.

The nephrostomy tube should emerge from the middle or preferably the lower calyx and traverse the layers of the wound without kinking. The tube, if necessary, may be brought out through a stab incision in the loin. Drainage by nephrostomy tube can be maintained for several weeks or permanently if necessary.

PREVENTION OF RECURRENCE

Recurrences have been estimated in the past as varying from 10 to 40 per cent. Whether or not these are "recurrences" is debatable. The urologist who does not routinely employ direct roentgenologic control at the time of operation is prone to call calculi that have been missed or left behind at the time of the primary operation "recurrences."

Priestley[2] has stressed the point that medical treatment should include bacteriologic studies of the urine before and after removal of the calculi, determination of the hydrogen-ion concentration of the urine, chemotherapy and antibiotic therapy in an effort to combat infection in the urinary tract, studies of blood phosphorus and blood calcium to rule out the presence of hyperparathyroid adenomas, and the elimination of all distant foci of infection.

Chemical analyses of the removed calculi should be made and may reveal errors of metabolism.

Surgical treatment should include correction of any obstructive factors predisposing to stasis, infection, hydronephrosis and stone formation. In many cases plastic repair can be carried out at the time of nephrolithotomy or pelviolithotomy. Often the condition of the kidney or of the patient is such that plastic repair to insure adequate drainage and satisfactory renal function must be postponed until a later date.

URETERAL CALCULI

Many ureteral calculi are expelled spontaneously and a considerable number can be removed transurethrally, employing any one of several methods. Loop catheters, basket dislodgers and the use of multiple indwelling catheters or ureteral filiforms for forty-eight to seventy-two hours have proved effective in removing stones that are not impacted; the latter require surgical removal.

The ureteral stone causing acute renal blockade constitutes another problem. Renal function is temporarily suppressed and because of this the organ often is needlessly sacrificed. One is justified in making several attempts to dislodge such a calculus transurethrally; but when infection accompanied with chills and fever supervenes, surgical intervention becomes necessary. Because cortical infection is present in many of such cases, it is advisable to inspect the kidney through the usual lumbar incision and, if necessary, perform decapsulation and neprostomy before proceeding to remove the ureteral calculus. The calculus is removed through an extended incision or, if it is in the lower part of the ureter, by turning the patient on his back and employing the Gibson incision.

SUMMARY AND CONCLUSIONS

General principles to be observed in the removal of renal and ureteral calculi, and their importance to the prevention of recurrences, are discussed.

A preference is expressed for the use of ureterolithotomy and pelviolithotomy, and even for ureterolitholapaxy, rather than extensive pole-to-pole nephrotomy.

The more widespread use of direct roentgenologic control at the time of operation to reduce the incidence of "false" recurrences is recommended.

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SURGERY OF THE ESOPHAGUS THROUGH THE RIGHT CHEST*

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IN recent years radical resection of the esophagus has been performed with increasing frequency accompanied with a decreasing incidence in morbidity and mortality. The success of this operation owes much to the investigations, clinical experience and writings of Phemister, Sweet, Churchill, Garlock and Pack, to name a few. However, most of the credit for the present success is due to: (1) the present methods of anesthesia and the competent physician anesthetists; (2) the use of large volumes of readily available blood; (3) the proper use of antibiotics and (4) better preoperative preparation and postoperative care.

Ivor Lewis, a British surgeon, initiated a new operation for resection of the middle third of the esophagus and published an account of his two-staged abdominal and right thoracic approach in 1946.[1] Lewis thought that this operation could be done in one stage but had not done so himself at the time of publishing his paper. In 1948 Macmanus published his experience with this procedure in two patients and proposed that the right crus of the diaphragm be divided in order to facilitate drawing the stomach cephalad through the esophageal hiatus.[2] He also suggested that at the second stage the rib selected for resection be the one whose neck is on a level two vertebrae above the upper border of the esophageal lesion.

Kent and Harbison presented their results and conclusions regarding the Lewis technic to the American Association for Thoracic Surgery in 1949.[3] They operated upon seventeen patients and were well satisfied that the access to the esophagus was much better from the right side of the chest than from the left. They found the abdominal stage to be somewhat more difficult and tedious than Lewis indicated and for this reason were unable to accomplish the operation in one sitting. This article stimulated a very interesting discussion. Paine of Buffalo reported that he and Macmanus had done the operation at one sitting in twenty-five cases. Johnson of Philadelphia stated that he preferred opening the right chest to demonstrate resectability of the lesion and then after turning the patient back slightly making a left subcostal incision to free the stomach which then can be passed into the chest by an assistant. Sweet and Garlock criticized the operation sharply because of the operative risk involved in a difficult abdominal mobilization of the stomach followed by a transthoracic operation which might reveal the lesion to be inoperable. Sweet expressed the opinion that the stomach can be better mobilized through a thoracic approach and that he can resect a mid-esophageal tumor in 72 per cent of the cases when working in the left chest. Although he had not tried the right thoracic approach, he stated that if he were to use it he would do the operation at one sitting. In view of the stature of these critics this discussion may have given pause to many individuals who might otherwise have attempted the operation.

Several additional papers concerning the right thoracic approach have appeared recently and more are sure to come. Mathewson and Cohn reported seven cases to the Western Surgical Association in 1949.[4] Harrison and Pickett presented their one-stage simultaneous abdominal, thoracic and cervical incisions for upper esophageal lesions in 1950.[5] Madden proposed this approach for congenital atresia of the esophagus.[6]

INDICATIONS, ADVANTAGES AND DISADVANTAGES

The two lesions most likely to require resection of the esophagus are carcinoma and stricture, with the former predominating. Experience with these lesions shows that the pathology of each process is apt to extend upward and downward much farther than is

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usually realized on the roentgenographic and endoscopic examinations. Consequently, the operator must take this into consideration when planning his attack.

Any lesion at or above the level of the seventh thoracic vertebra approached from the left side will require transection so high that the anastomosis must be made above the arch of the aorta. In carcinoma this is necessary in order to perform adequate cancer surgery. In stricture good healthy esophageal tissue will usually not be found low enough to permit an anastomosis below the arch of the aorta. Therefore, we believe that the left-sided transthoracic approach should be used only for those lesions of the esophagus below the level of the seventh thoracic vertebra or, stated differently, below 32 cm. from the incisor teeth as measured by the esophagoscopist. (Fig. 1.) All lesions above this level including those in the cervical esophagus should be attacked through the combined abdominal and right thoracic approach. Macmanus[2] has advised its use even for lower third lesions.

We prefer the combined approach because it has certain definite advantages which can be classified into groups:

Group I, Better Exposure and Easier Dissection. Generally speaking adequate exposure is one of the prime requisites of all surgery and any incision which improves exposure is the preferred incision. From the right thoracic cavity the thoracic esophagus can be fully exposed in its entirety because it is not obscured by the descending aorta as it is from the left side. The descending aorta and aortic arch instead of being an obstacle, become a safety barrier between the surgeon and the other pleural cavity. Instead of having to separate the esophagus blindly from behind the aortic arch it can be dissected under full vision and it is unnecessary to tease the esophagus out from behind the arch.

Division of the azygos vein and incision of the mediastinal pleura lays bare the entire thoracic esophagus. Tumor which involves the azygos vein can be resected under full vision from the right side whereas from the left the vein must be handled almost blindly with great danger of hemorrhage.

The posterior surfaces of the trachea, carina and right main stem bronchus are under direct vision and can easily be dissected free from the esophagus and its tumor. The hilar lymph nodes can be seen and handled more easily.

An anastomosis near the apex of the left chest above the arch of the aorta is somewhat awkward for a right-handed operator, but a high anastomosis can be done with much more ease in the right chest cavity. This fact might influence the operator in a selection of the height of amputation and it enhances the integrity of the anastomosis.

Because the stomach has been fully mobilized during the abdominal portion of the operation, the operator knows that he can easily place it in the apex of the chest cavity. Therefore, when working on the right side of the chest if he encounters a tumor impossible to remove or unwise to remove because of the patient's condition, he can fairly easily divide the esophagus above the lesion and carry out a by-pass anastomosis with the stomach. He might well hesitate to do this on the left side when he knows he has a difficult and tedious dissection ahead of him merely to get the esophagus from behind the aortic arch. We believe that almost all tumors can be removed and should be removed for palliation even though much tumor tissue is left behind; so the by-pass operation should seldom be necessary.

Group II, Better Cancer Surgery. Because of the anatomic relationship and exposure a better *en bloc* dissection can be done with careful hemostasis since the vessels are readily seen entering the esophagus. The hilar structures can be cleaned out by sharp dissection.

Even the strongest advocates of the left-sided approach warn of the tendency to transect the esophagus too close to the lesion. This is especially bad in carcinoma because of the extent of submucosal extension of tumor. There should be no such tendency in the right-sided approach because the esophagus can be dissected free more easily and an anastomosis can always be made at the apex of the chest.

Making the abdominal incision before the chest incision allows the surgeon to determine extensive nodal and hepatic metastases which oecasionally may cause him to terminate surgery without the necessity of a thoracotomy.

Group III, Improved Physiologic Factors. The combined approach causes little interference with the respiratory mechanism. The chest cavity is not open so long because the stomach does not have to be dissected free

while the chest is open, and the improved exposure shortens the time of esophageal dissection. The patient's tussive ability is not impaired, because the phrenic nerve is not crushed and the diaphragm is not cut. For a portion of the operation the patient is on his back which

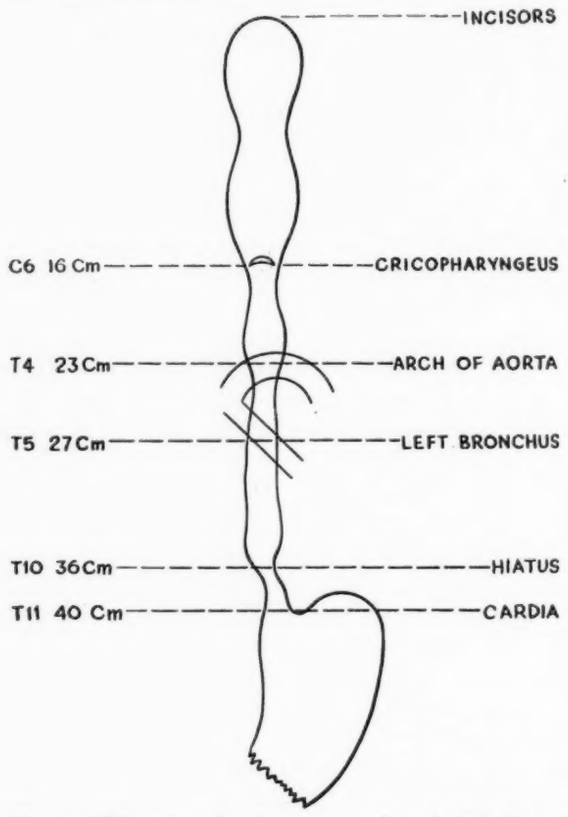

FIG. 1. Diagram showing anatomic relationship of esophagus to important structures of chest with average distances of these from the incisor teeth as measured through the esophagoscope.

allows the anesthetist to get him well stabilized bofore the more shocking chest procedure is done.

It is believed that cardiac irregularities can be caused by manipulation about the arch of the aorta. These are minimized because of the more favorable conditions of dissection about the arch from the right side.

Dr. Sweet and Dr. Garlock[3] adequately expressed the disadvantages of this operation which are mainly two: (1) The abdominal portion of the operation can be a major surgical procedure which poses a real risk for the patient; (2) the thoracic portion of the operation may reveal a hopelessly incurable or nonremovable tumor. We agree that the first objection may be encountered but we have found it so in only one of our own cases. Occasionally when the left chest has been opened and the diaphragm divided, numerous nodal and hepatic metastases are found which obviate cure or even adequate palliation, so the second disadvantage has its counterpart in the left-sided approach. It should also be mentioned here that any incision in the diaphragm is an incision into the abdominal cavity just as much as one made through the anterior abdominal wall. Therefore, those users of the left thoracic approach are actually entering two body cavities just as surely as those who use the combined approach. Anyone who has closed a large incision in the diaphragm is well aware that it requires as much care and time as closure of the anterior abdominal wall.

TECHNIC

Our preference for attacking surgical lesions of the middle and upper thirds of the esophagus is as follows: With the patient in the supine position and under intratracheal anesthesia a midline supraumbilical incision is made. The incision is carried to the left of the xiphoid process to gain room. In hypersthenic body types it may be necessary to vary the incision in order to gain adequate exposure of the gastric fundus and esophageal hiatus. We prefer to incise the left costal margin if necessary. Transverse limbs placed at the inferior end of the incision may be useful. The abdominal cavity is explored. Metastatic carcinoma in the liver contraindicates further surgery unless a single lesion can be excised. The palliation gained by resection of an esophageal carcinoma justifies partial hepatectomy for a single metastasis. Palpable metastases about the coelic axis are subjected to the same reasoning.

The lesser omental bursa is entered through the gastrocolic mesentery and the entire greater curvature of the stomach is mobilized by ligating and dividing the branches of the gastroepiploic vessels to the omentum. This preserves a continuous arcade of vessels supplying the greater curvature. (Fig. 2.) The short gastric vessels are ligated and divided. The left gastroepiploic artery is secured at its site of origin and ligated and divided. The spleen is preserved. The stomach is rolled to the right and is separated from the pancreas by sharp and blunt dissection. The left gastric artery and coronary vein are carefully delineated, ligated and divided. The gastrohepatic mesen-

tery is divided fairly close to the liver in order to preserve an arcade of vessels on the lesser curvature of the stomach. Ivor Lewis recommended that fine silk ligatures be used when freeing the stomach in order that there would be fewer adhesions to interfere with drawing the stomach into the chest during the second stage of the operation. In a single stage procedure this reasoning is not applicable. We do prefer fine non-absorbable material and pay particular attention to ligate individual vessels well free of areolar tissue so that the mesenteries will not be bunched. Mass ligatures tend to prevent obtaining maximum length of the stomach.

The abdominal portion of the esophagus is freed by sharp and blunt dissection so that no areolar tissue is attached to it. The esophageal hiatus is dilated with the index and middle fingers of the right hand. Careful dissection about the pylorus and duodenum is designed to preserve the right gastric and right gastroepiploic arteries. It has been shown that these two arteries are ample to insure adequate blood supply to the stomach. In fact, it is probably feasible to sacrifice all but the right gastric artery. The peritoneum lateral to the second portion of the duodenum is incised and the duodenum rolled medially. It should be possible to place the pylorus at or near the esophageal hiatus. We have not seen nor heard of interference with emptying of the biliary tract from this procedure. Some of our patients have had postoperative delay in emptying of the stomach, presumably due to the gastric atony secondary to vagus section. Although we have not practiced pyloroplasty, we believe that it might aid gastric emptying and therefore help prevent regurgitation and esophagitis.

The abdomen is closed with interrupted nonabsorbable sutures to the linea alba and through and through retention sutures of silk or stainless steel wire. The abdominal portion of the operation usually takes about one and one-half hours depending on the patient's habitus and the ease of dissection of his tissues. The patient is now placed on his left side and the skin of the right side of his chest prepared and draped during which time the surgical team sits down and rests. The chest is entered through the bed of the right fifth rib which is preferred because it provides better exposure of the area behind the carina and makes the anastomosis easier to perform at a high level. One-inch paravertebral sections of the fourth and sixth ribs are removed. This aids exposure, prevents breaking of ribs when the ribs are spread with the retractor and minimizes postoperative pain because it is not necessary to dislocate the costovertebral articulations during spreading of the ribs.

When the chest is opened, the site of the lesion is carefully inspected and palpated. Frequently it is impossible to determine resectability until the dissection is well advanced. The azygos vein is divided between double ligatures. The mediastinal pleura over the esophagus is incised longitudinally. The esophagus is bluntly circumscribed below the lesion and the dissection commenced about the lesion. This is often a difficult tedious procedure. It may be necessary to free the lesion from the carina and the aorta without entering either structure. (Fig. 3.) If the thoracic duct can not be preserved, it should be divided between ligatures. We believe that most carcinomas should be removed even if malignant tissue must be left behind. Submocosal extension of the tumor is usually many centimeters above and below the lesion, so the esophagus is freed as high as possible. The distal esophagus is mobilized to the hiatus which is dilated quite vigorously with the fingers of one hand. Traction on the esophagus delivers the stomach into the right chest cavity with ease. The stomach is not sutured to the hiatus. The esophagus is ligated and divided at the esophagocardiac junction and the stump on the gastric side inverted with a purse-string suture reinforced with a layer of Lembert sutures of silk. This avoids interference with anastomotic vessels at the cardia.[7] The stomach is pulled upward into the right chest behind the hilus of the lung and the cardia reaches to the apex of the chest cavity with ease. (Fig. 4.) We follow Sweet's method of anastomosis. A circle of tissue is cut out of the cardia and a two layer anastomosis of interrupted No. oooo cotton or silk accomplished between this opening and the cut end of the esophagus. The stomach in several places is sutured to the pleura over the vertebral bodies. A large Foley catheter is brought out through a stab wound in the tenth interspace and the chest wall is closed in layers.

We have had occasion to extend the intrathoracic dissection of the esophagus upward into the neck in order to get above submucosal extension of tumor. This was done by finger

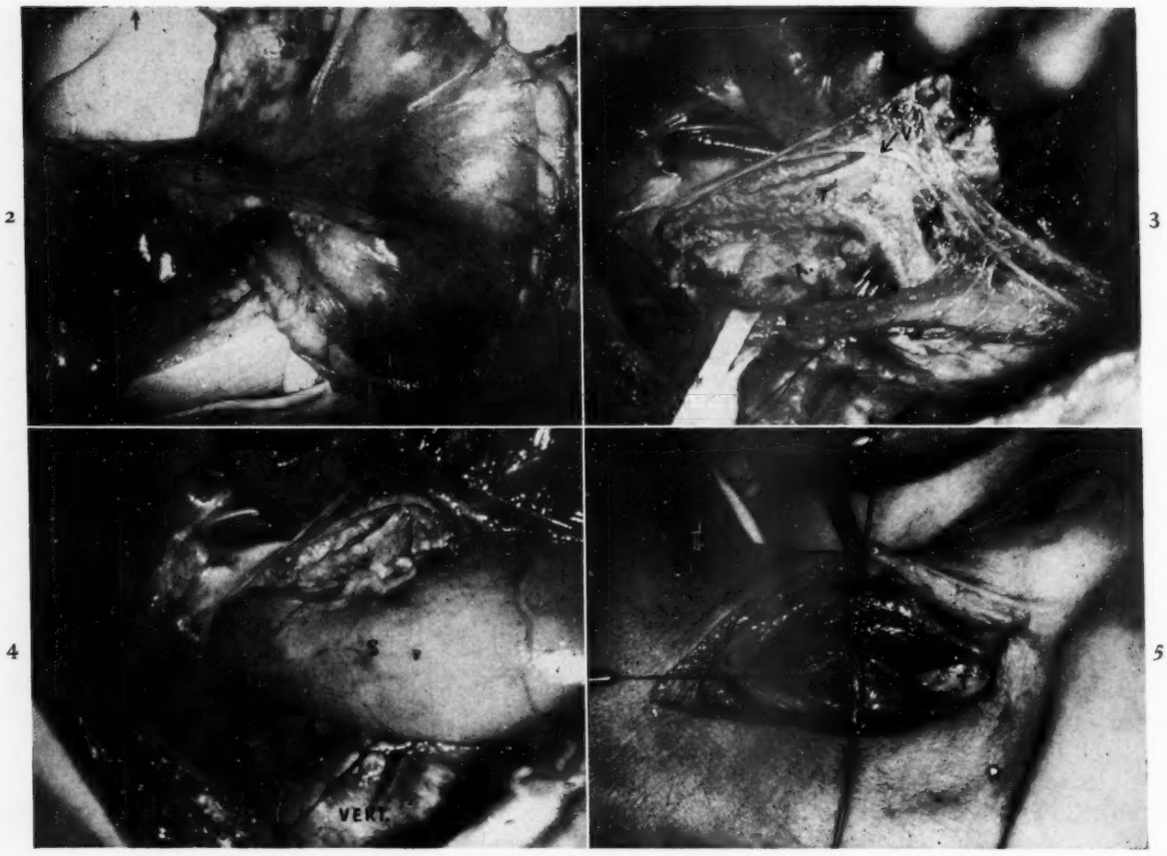

FIG. 2. Cadaver dissection; stomach (S) mobilized through midline supra-umbilical incision. Arcade of vessels preserved on greater curvature. Duodenum has been mobilized. Note proximity of pylorus (P) to esophagus (E) after mobilization. Liver (L). Arrow points cephalad.

FIG. 3. Cadaver dissection; superior mediastinal structures seen from right side of chest after mobilization of upper thoracic esophagus. Esophagus (E) lies to right of aortic arch (A. A.) and trachea (T). Note vagus nerve (V) crossing right main stem bronchus. Note phrenic nerve crossing superior vena cava (S.V.C.).

FIG. 4. Cadaver dissection; stomach (S) lying in right chest with fundus at apex of chest. Vertebral column (Vert). Apex of right thoracic cavity (*).

FIG. 5. Cadaver dissection; cervical incision and exposure. Esophagus (E) amputated just below cricopharyngeus muscle. Beginning of anastomosis between esophagus and fundus of stomach (S). Thyroid (Th.); trachea (T).

dissection behind the great vessels. The esophagus was amputated high and the cardia of the stomach placed in the root of the neck and tagged with long black silk sutures. After the chest was closed the patient was placed on his back and the cervical esophagus exposed through an incision placed along the anterior border of the right sternocleidomastoid muscle. The right inferior thyroid artery was sacrificed in order to reamputate the esophagus just below the level of the pharynx where the esophagogastric anastomosis was made. There was some difficulty encountered in grasping the stomach with a Babcock forceps placed from the neck into the chest through the superior thoracic inlet; but once it was delivered into the neck, the anastomosis was accomplished easily without tension. (Fig. 5.) Because of this experience we believe that it would be preferable to make the neck incision and dissection prior to closure of the chest, so that the stomach can be guided into the neck more easily.

Such long tedious procedures are tiring to the surgical team. We believe that a second team, or at least an alternate surgeon, can be used to good advantage in performing some of the routine portions of the operation in order that the surgeon and his assistants can take a rest period.

Two of the resident surgeons at Los Angeles

County General Hospital, Dr. William Mikkelson and Dr. Frank Rogers, proposed a two team simultaneous abdominal and right thoracic approach which was utilized to good advantage in one case. The patient was placed on his left side with the back tilted about 30 degrees toward the table. The abdominal and right thoracic cavities were entered simultaneously. This allowed exact determination of resectability early in the operation. The stomach and esophagus were mobilized simultaneously. Some difficulty in exposure was encountered by both operators, but this could probably be corrected by careful placing of the patient on the table. The entire operation was accomplished in less than four hours, thereby saving one and a half to two hours.

CASE REPORTS AND COMMENTS

For the reader's convenience the pertinent data concerning each case is presented in Table 1.

Although cancer of the esophagus occurs predominantly in men in the latter decades of life, three of this group were women and three of the patients were under fifty years of age. There were many preoperative complications in these cases, but no patient was denied surgery because of a complicating condition.

If one compares the level of the lesion as found on esophagoscopy with the level of the anastomosis, it is noted that either the operator clinically believed that the lesion extended higher than described by the esophagoscopist, or he was careful to amputate the esophagus

TABLE 1

Case No.	Age and Sex	Duration of Symptoms (mo.)	Preoperative Complications	Level of Tumor on X-ray	Level of Tumor Esophagoscopy (cm.)	Level of Anastomosis	Postoperative Complications	Survival Time
1	66,M	2–3	Old myocardial infarction	Mid-esophagus just inferior to arch of aorta	27	Apex of chest cavity	Myocardial infarction and congestive failure	8 days
2	61,F	3	None	5 cm. above left diaphragm	36	Behind carina	None	9 mo., well
3	71,M	6	Old fracture, right hip; cataracts; mild hypertension; pneumonia after esophagoscopy	Below arch of aorta	33	Opposite T-2 and 3	Atelectasis; pneumonia	3 mo., condition unknown
4	48,M	8	None	Not done	21	Opposite T1–2	Anastomotic leak with hydropyopneumothorax	1 mo. 8 days
5	45,F	2	Chronic alcoholism	Junction of middle and lower third	31	Above azygos	None	4 mo., died
6	45,F	5	Pneumonitis	Opposite T-7	34	Opposite T3 and 4	Pneumothorax pneumonitis	8 mo., well
7	55,M	3	None	Opposite T3–6	22	Opposite thyroid cartilage	None	6 mo., well
8	72,M	7	Severe anemia; cachexia	Opposite T-11	34	Below arch of aorta	Shock; atelectasis; pneumonia	3 days
9	59,M	5	None	Level of hilum of lung, 4 inches in length	26	5 cm. superior to azygos vein	Pneumonitis; pleural effusion	3 mo., living

far proximal to the tumor. With this technic there was no problem in doing a careful high anastomosis. We feel certain that if some of these cases had been done from the left side, there would have been a strong temptation to amputate the esophagus just below the arch with the great likelihood of cutting through tumor.

In Cases 3, 6 and 7 it was necessary to dissect the lesions off the carina by sharp dissection. Probably these cases would have been abandoned if we had been using the left-sided approach. In Case 6 a small hole was made in the left main stem bronchus which was easily repaired.

There was a high incidence of postoperative complications but this runs parallel to preoperative complications (Cases 1, 3, 6 and 8). We have no ready explanation for the anastomotic leak in Case 4. The anastomosis was easily performed and there was no tension on the suture line. In Case 6 the complications were not of a severe degree and may have been due to a poorly functioning thoracotomy tube immediately postoperatively.

Case 7 presented a very extensive lesion extending submucosally into the cervical esophagus. A simultaneous abdominothoracocervical approach was made and the stomach anastomosed at or just below the pharynx. Tumor was left in the chest. The patient has made a remarkable recovery and is quite comfortable.

In retrospect, Case 8 probably would have done better if the abdominal portion of the operation had been done at the first stage. The thoracotomy could have been done a few days to a week later. The freeing of the stomach was both difficult and bloody. During this time the patient's systolic pressure was between 80 and 100 for thirty minutes, but on the completion of the abdominal procedure his general condition was satisfactory and his pressure had returned to normal so it was decided to continue the operation.

Case 9 is worthy of special mention. This patient had a very high, extensive lesion. He was operated upon by two teams simultaneously. The total operating time was three hours and thirty minutes. We believe that more cases should be done in this manner since it seems likely that this might significantly lower operating time. We are not advocates of excessive speed in surgery, yet it seems logical that the shorter the operating time the less likelihood of shock, the smaller the amount of anesthetic that needs to be administered, the lower the incidence of chest complications and, therefore, the better the patient's postoperative convalescence.

SUMMARY

Exposure of the esophagus through the right chest as proposed by Ivor Lewis in 1946 is technically more simple than exposure through the left chest. It also enables the surgeon to do better cancer surgery, and there is less interference with respiratory mechanics and cardiac regulatory mechanisms. In nine cases we have been satisfied with the access to the esophagus through the right chest. For these reasons we believe it should be used in all cases of carcinoma of the esophagus lying above a level 32 cm. from the incisor teeth.

Addendum: Since preparation of this article for publication, two other patients have been subjected to simultaneous two-team exploration as referred to in the text. One had a total esophagectomy for stricture in three hours' operating time. The other had a subtotal esophagectomy for carcinoma in three and one-half hours' operating time. Both patients are living and eating well without distress.

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CANCER OF THE BREAST*

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CANCER of the breast is not new. In the first century A.D. Leonides[1,2] operated upon the breast for cancer, using a red hot iron to sear the remaining surfaces. Antyllus[1] also operated upon the breast in the third century. In 1804 Benjamin Bell[1] insisted that local operations were of no avail and urged that wider operations were necessary and suggested that the pectoral muscles and axillary lymph nodes be removed. Up to this time almost 100 per cent of patients had recurrences and died. Charles Moore[1] in 1867 emphasized that neck dissection be performed *en masse* and in continuity. Sir Mitchell Banks[1] in 1882 taught that removal of the axillary lymph nodes was necessary whether they seemed enlarged or not. Halsted[3] and Willy Meyer[4] in 1894 separately described an operation which has been the basis for our surgery to date. Halsted removed the breast first, followed by the axillary dissection. Meyer reversed this order. Halsted removed a large amount of skin, necessitating skin grafting in most cases. He later described a more radical operation, entering the neck and removing the lymph nodes in the posterior triangle.

L. McLane Tiffany[5] in 1901 drew attention to the intercostal spaces where nodes could sometimes be found and removed. Sampson Handley in 1904[6] and again in 1921[7] emphasized that the spread of cancer was by lymphatics which coursed chiefly in the fascial planes. He stated that wide areas of fascia therefore should be removed, including the fascia over the epigastrium and the upper part of the rectus abdominus muscle. He believed that since cancer did not spread along the skin, it was not necessary to remove wide areas. We are indebted to him for the rule that at least 6 inches of skin, centered over the tumor, plus 10 inches of deep fascia, including that over the rectus muscle and epigastrium, should be removed.

In 1895 Roentgen[2] discovered x-rays and soon after that a patient with a large cancer of the face was treated with roentgen rays. The tumor shrank away rapidly and disappeared. Marie and Pierre Curie[2] discovered radium and later this was made available for therapeutic use against cancer. Soon a technic was developed for a combination of surgery plus radiation. Radium was used but gave way to x-ray preoperatively, postoperatively, or both. Radiation combined with radical surgery was considered better than either alone. We had now reached a stage where it was believed that the treatment of cancer of the breast had become standardized. However, our tranquility did not last long. New and conflicting ideas emanate from so many authoritative sources that we are now in a state of uncertainty.

In a recent article Charles Eckert and William B. Seaman[8] summarize their ideas on radiation therapy as follows: "Irradiation offers definite palliation, prolongation of life and occasionally even five-year survivals are seen in the group of primary inoperable cases. Preoperative radiation serves to surround the cancer cells with a fibrous tissue barrier. If surgery follows, it effectively breaks down this barrier so that life is often shortened over what it would be from x-ray therapy alone." They also state that postoperative radiation is not called for unless there are very high nodes in the axilla and the surgeon believes he has probably left some lymph nodes or extension which he cannot reach. This view is held also by Haagenson[9] and others.

However, Janes[10] and Jones[11] both report satisfactory results in a small number of cases treated preoperatively. Janes reported two advanced cases treated by preoperative radiation. Both patients are alive and free from recurrence eleven and six years, respectively. A. Nohrman[12] reports a series of 1,042 cases in which there appeared to be an improvement in prognosis in the most unfavorable cases. The author has used preoperative x-ray therapy in a number of cases and has noted marked clinical improvement. In many cases the

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breast tumor shrank and in some cases there was difficulty in finding the tumor in the gross specimen. Similar changes are seen in the axillary and supraclavicular nodes. McWhirter[13] claims 29 per cent five-year survivals in inoperable cancer of the breast when no distant metastases are present. His treatment is radiation alone.

In America less reliance is being placed on radiation. Preoperative x-rays are now considered of little value and may cause harm through delay. There is now a feeling that postoperative x-ray therapy is useless and may do harm. Most authorities now place their principal reliance on wide and thorough radical surgery.

It is usual to precede radical surgery with a biopsy. Here again there is a conflict in our thinking. Many prefer needle biopsy while others think open surgical biopsy is preferable. Needle biopsy is best performed by a pathologist of wide experience. He may use a Silverman needle or a large bore hypodermic needle attached to a syringe. The cells are placed on a slide and immediately stained and examined. An expert may become quite proficient in this method of diagnosis. However, in other hands it is not recommended because the pathologist must use cytology and not histology. Forcing a large needle through hard cancerous tissue requires a considerable amount of force and the rough handling tends to squeeze cancer cells out into the lymphatics. The cancer may be quite small and escape the needle. There may be a small cancer present in addition to a larger area of cystic mastitis. Obviously, it would be easy to aspirate the cysts and miss the cancer.

Open biopsy has been the common procedure for many years. Wide excision of the tumor mass was considered the proper method. We are now told that this procedure cuts across lymph channels and even extensions of the tumor. W. C. White and Brandes[14] have demonstrated cancer cells in the water in which the hands were rinsed after such biopsies. It is stated now that a biopsy performed by exposing the tumor and removing a wedge of tumor tissue with a sharp knife is safer. This method would be more acceptable if the cut area were cauterized immediately. We prefer to use the wide excision method, using the diathermy knife which also sears over the lymphatics and prevents spread of cancer cells. Careful handling of the tumor must be emphasized since massage and squeezing may force cancer cells into the lymphatics. If the biopsy is positive, the wound is packed with gauze wet with formalin and then sutured tightly to prevent leakage. A new complete surgical setup including drapes, gloves and instruments must be insisted upon.

Then we proceed with the radical operation. I described an operation in 1942[15] and will not repeat the details here. There are some phases, however, which need comment. Even 100 years ago surgeons understood that cancer did not spread along the skin. There is a recent tendency by many surgeons to remove large areas of skin and to leave the balance very thin. These men use skin grafts in nearly all cases. There is not sufficient evidence to substantiate this procedure. It is necessary to remove 5 to 6 inches of skin centered over the tumor but more is not necessary. We must be careful, however, not to leave any breast tissue attached to the skin flaps. For the most part, sharp dissection is advisable for any type of surgery. Where there is such a wide area with so much fatty areolar tissue, the judicious use of gauze greatly facilitates the clearing process. Haagenson[9] states that his operations average five hours and believes the value of an operation may be measured by the time spent. We are striving for better results and the most effective way to accomplish this is to perform this operation with greater skill and meticulous care.

While everyone agrees that radical surgery is our chief hope in cancer of the breast, there is tendency for some to reduce the range of inoperability. Definite criteria of inoperability are laid down by Haagenson and Stout[9] as follows: (1) carcinoma developing during pregnancy and lactation; (2) extensive edema of the skin over the breast; (3) presence of skin satellite nodules; (4) presence of intercostal or parasternal nodules; (5) edema of the arm; (6) presence of proven supraclavicular nodules; (7) inflammatory carcinoma; (8) distant metastasis; (9) when any two or more of the following signs of locally advanced carcinoma are present: ulceration of the skin; edema of the skin of limited extent (less than ⅓ of the skin over the breast); fixation of the tumor to the chest wall; axillary lymph nodes measuring 2.5 cm. or more in transverse diameter and proven to contain carcinoma by biopsy; fixation of axillary lymph nodes to

skin or deep structures and proved to contain metastases by biopsy. Haagenson and Stout's figures showed that not one patient survived five years who fitted into the aforementioned criteria.

While most agree that it would be folly to operate upon obviously inoperable patients, many of us will not agree that the picture is always so black. There are many borderline cases which the author believes may be made operable by preoperative radiation. Others report better results in pregnancy and lactation.[16] There is always a possibility of removing a single distant metastasis. A pneumonectomy is occasionally performed in such cases with such a single metastasis. Only a large series will tell us whether this is worth while.

The presence of supraclavicular nodes certainly lowers the prospect of possible cure. However, we operate for glandular metastases from carcinoma of the thyroid, larynx, and mouth; so why not for cancer of the breast? Recurrent nodes appearing late in the neck should be attacked immediately by block dissection. On the left side the thoracic duct should be found so that all lymphoid tissue can be removed down to this point. The duct winds forward over the medial edge of the scalenus anticus muscle to reach the jugular vein. In one of my patients a mass of metastatic nodes appeared in the supraclavicular area following radical mastectomy. A block dissection was performed and this patient is alive and well four years later without any evidence of recurrence. Having in mind that operation seems to be our best hope, some of us have thought of extending the scope of surgery. Wangensteen[17] recently suggested dividing the clavicle to allow dissection of the neck in continuity with that of the axilla. This allows clearing all the adventitia from between the cords of the brachial plexus. He also suggests removal of a large section of the first rib. This would enable the surgeon to follow the axillary vessels up into the superior mediastinum and remove lymph nodes which might contain metastasis. Where the tumor is in the medial half of the breast, lymphatics are known to carry cancer cells along the perforating branches of the internal mammary artery into the chain of nodes located along this vessel. To attack these, it is a relatively simple matter to remove the costal cartilages of the second, third and fourth ribs. The internal mammary artery and its accompanying lymph tissue may then be removed.

COMMENTS

1. Earlier diagnosis is imperative. The physician should never watch a case but should rely only on microscopic diagnosis of the excised tumor. After biopsy a complete new set of instruments, gloves and drapes are necessary before proceeding with the radical operation. We believe that failure to do this is responsible for local implantations of cells causing recurrences.

2. The rules or criteria of operability quoted previously should not be considered as absolute. Certainly adherence to these rules will give us better statistics. However, it must be remembered that patients who are refused surgery are doomed to die. Palliation may be obtained with radiation therapy but cures cannot be expected. Many of us believe that there are borderline cases that have a chance of salvation. It is my opinion that preoperative radiation has not been given sufficient trial and that some of these cases can be made operable by such treatment. Great improvement in operative technic is needed. There is no other operation which requires such meticulous care.

3. Instead of curtailing our criteria for operability many of us believe that we should explore the possibility of widening the scope of surgery. Wangensteen and others have been including supraclavicular dissections, superior mediastinal glands, removing and dissecting the internal mammary artery with its accompanying lymphatics. The author has removed recurrence in supraclavicular nodes with five-year survival. Many patients who have been classified as inoperable have been operated upon with good results. Certainly the results of this more radical operative method will be watched with interest. It would seem that the issue is not closed and that only by reaching out to the frontiers can progress be obtained.

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ISCHEMIC FIBROSIS OF THE LOWER EXTREMITY IN CHILDREN*

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ALTHOUGH ischemic fibrosis of the musculature of the upper extremity is a well known clinical entity, such an involvement of the lower extremity is relatively uncommon in adults and rare in children. Volkmann[1] in 1881 mentioned the occurrence of this condition in both upper and lower extremities, while Meyerding,[2] Albert and Mitchell,[3] and Stanford[4] described similar changes in the muscles of the lower extremities.

Because of the serious irreversible changes and the secondary deformities produced by ischemic fibrosis the authors believe it is worth while to report in detail seven cases in which this syndrome was found in the lower extremities of young children. It is hoped that on the basis of an examination of such data certain criteria could be set up for the early recognition of the condition.

Clinical Material. The patients whose cases are reported herein came to our attention as consultants on a large children's fracture ward. In each instance the ischemic fibrosis was observed while the patient was being treated for a fracture femur. In six instances therapy consisted of Bryant's traction, and in one, the application of a cast. In three of the seven cases the ischemic fibrosis occurred only in the normal extremity while in the other four it was present on the same side as the fracture.

The age of the patients varied from three to five years; six children were Negroes and one was Caucasian. Six of the cases were observed within twenty-four to forty-eight hours after the onset of the ischemic fibrosis. Despite the fact that treatment was instituted immediately after the recognition of the condition, irreparable damage had already occurred and the deformity became progressive and permanent. The remaining case came under our observation in the clinic several months after the patient had sustained a fracture of the femur. By this time definite findings of ischemic fibrosis were apparent.

CASE REPORTS

CASE 1. E. M., a four year old boy, was admitted to the hospital immediately after having been run over by a truck. He sustained multiple fractures of the pubes, the mandible and both femurs; the right at the middle third, the left at the supracondylar region. Initial shock was treated with plasma and the patient was placed in bilateral Bryant's traction. Thirty-six hours following admission and application of traction it was noted that the right foot was cool and somewhat cyanotic. The bandages were removed immediately and the extremity was rewrapped without compression. Twelve hours later the right foot appeared cold and white. There was moderate ecchymosis about the ankle joint. (Fig. 1.) The leg was again rewrapped but the foot remained cold and pulseless. The following morning 2.2 cc. of tetraethylammonium chloride were given intramuscularly but there was no change in the appearance of the foot. Then Bryant's method of traction was replaced by traction in the horizontal position but still the foot remained edematous and cold and no pulses were palpable. A heat cradle was applied to the abdomen in an attempt to induce indirect vasodilatation.

Six days following admission, although the foot appeared somewhat warmer, the dorsum of the foot became necrotic. Skin temperature readings revealed slightly lowered temperature of the toes and dorsum of the foot. There was an increase in temperature immediately above the malleolus on the lateral aspect of the leg in the region of the inflamed area. At this time etamon chloride, .52 cc. in 500 cc. of saline, was administered. Temperature readings were done one hour later. It was noted that there was no change in temperature

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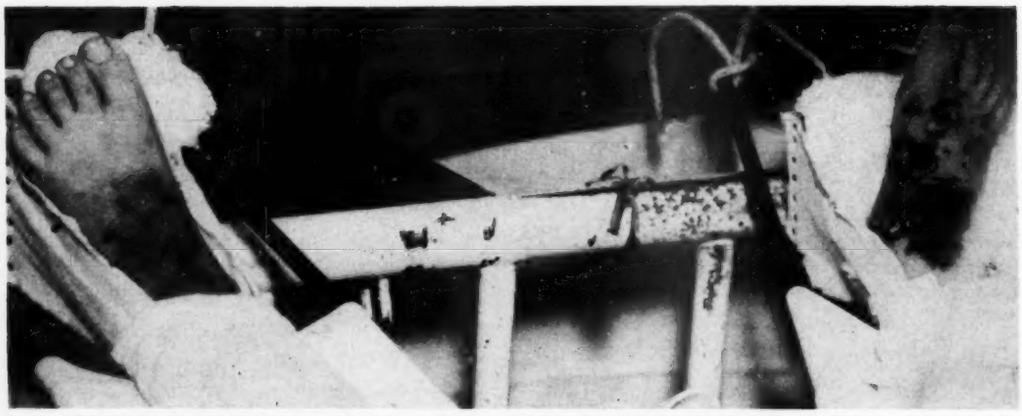

FIG. 1. Photograph of typical early change. Case 1. Four days after application of Bryant's traction to both lower extremities; edema and ecchymotic blebs are present.

FIG. 2. Photograph of typical deformity seen in late stage. Case 1. Fixed equinovarus position of right foot present eighteen months after fracture. Marked atrophy of calf muscle present.

readings on the dorsum of the foot. There was a slight increase of the temperature immediately above the toes and a moderate increase of from 34.8° to 36°C. on the plantar surface of the foot. Two weeks after admission the edema, swelling and cyanosis of the right foot were greatly diminished. On palpation the dorsum of the right foot was somewhat warmer than that of the left. All skin traction was removed at this time and skeletal traction by way of Kirschner wires was instituted and continued for approximately six weeks. The right calf was somewhat swollen, tender and painful. There was subjective numbness over the dorsum of the right foot immediately above the area of skin necrosis. Following final removal of traction it was found that the right foot had become markedly deformed in equinus. The right calf felt ligneous to digital palpation. Deformity at this time was marked. Physical therapy was instituted in the form of reflex heat, local massage and passive and active exercises.

Fourteen months after injury all the muscles of the right lower extremity were markedly atrophic and there was a severe equinovarus deformity of the foot (Fig. 2) despite constant vigilance and supportive casts. Except for some scarring the left foot showed no abnormalities.

CASE II. H. B., a four year old Negro boy, was admitted to the Cook County Hospital on June 29, 1946, with a simple fracture of the right femur. X-ray revealed a simple oblique middle third fracture of the right femur. Bryant's traction was applied immediately. The following morning it was found that the child had removed the traction and was lying in bed with the right lower extremity in marked deformity. The traction was reapplied immediately.

The morning of the sixth day after admission it was found that the left normal foot was swollen and cyanotic. That afternoon skin blisters developed on the left foot. (Fig. 3.) Rectal temperature rose to 100.2°F. The child was placed on a regimen of 30,000 units of penicillin every three hours. The foot became progressively more swollen and was cool to touch. An area of anesthesia developed over

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FIG. 3. Photograph of typical early change. Case 11. Six days after application of Bryant's traction for fracture of right femur; blebs and edema are present in left (normal) lower extremity.

FIG. 4. Same case. Photograph showing changes present two weeks after application of Bryant's traction. Early deformity and necrosis of skin of foot present.

the lateral portion of the leg and foot. The following day, seven days after admission, a sympathetic nerve block was done at the second and third lumbar levels; 5 cc. of 1 per cent novocain were used. No response was noted in color of the left foot or local temperature. The extremity was cold, blistered and markedly painful. The patient's temperature rose to 103°F. A marked vasospasm was diagnosed, with local thrombophlebitis. On July 8th caudal anesthesia was begun, but in spite of anesthesia to the level of the umbilicus the left foot remained cold. Three more injections of 10 cc. each were given in the next two days. The caudal catheter remained in site for approximately four days.

On July 12th there appeared to be some improvement with lessening of pain and swelling. The toe temperature was slightly increased and sensation in the foot returned to some extent. Movement of the left foot was not accomplished. The skin revealed marked necrosis over an area measuring 3 by 4 inches. (Fig. 4.) The greatest area of sloughing occurred between the first, second and third toes on the left foot. The metatarsophalangeal joint also revealed marked contracture.

A split-thickness graft was done on August 9, 1948, over the skin defect of the left foot. A final diagnosis of arterial spasm with local thrombophlebitis was made.

On November 8th marked equinovarus deformity was present with severe fibrosis and contracture of the gastrocnemius muscle

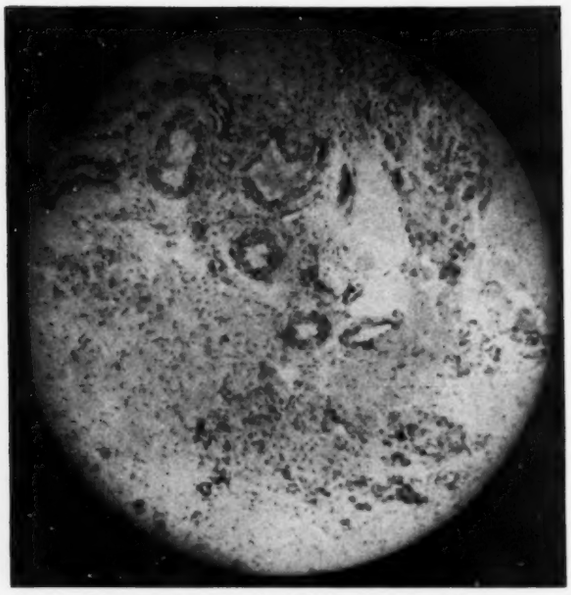

FIG. 5. Photomicrograph of biopsy from left gastrocnemius muscle obtained two years after onset of ischemic fibrosis. Case II. Muscle replaced almost entirely by fibrous tissue.

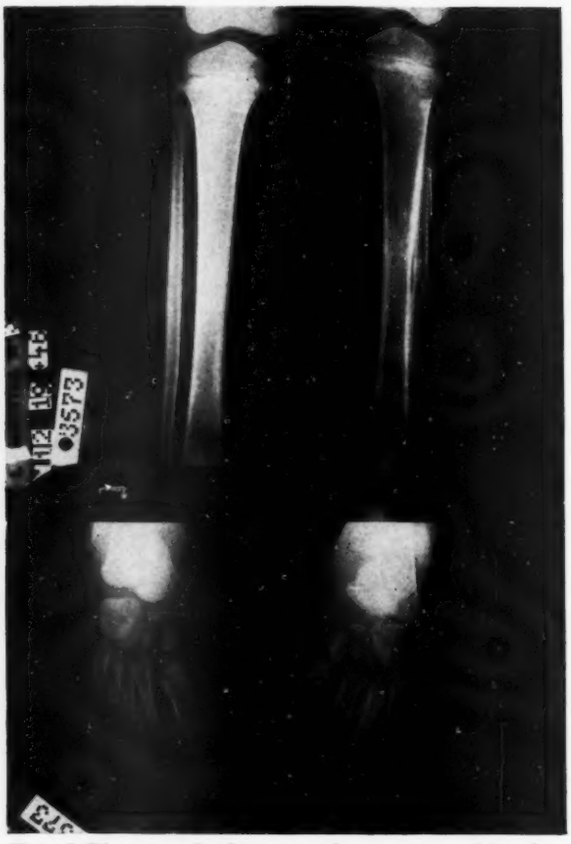

FIG. 6. Photograph of x-rays taken one year following development of fibrosis and deformity. Case III. Normal right foot and tibia demonstrate the relative decalcification of the entire left lower extremity.

Lengthening of the Achilles tendon and biopsy of the gastrocnemius muscle were done. (Fig. 5.)

CASE III. L B., a three year old Negro girl, was admitted to the Cook County Hospital on March 3, 1946, with a diagnosis of spiral fracture of the middle third of the right femur. Bryant's traction was applied the same day, both legs being suspended.

Two and a half days following application of the traction the right foot became cold and cyanotic. The elastic bandage was removed and reapplied. The toes appeared normal.

Thirteen days following admission the left extremity was cold and edematous, and skin necrosis of the left popliteal area was noted. Edema became marked and equinus deformity of the foot appeared. Dorsiflexion of the left foot could not be accomplished.

Two months after admission blisters developed in the left heel, with some cellulitis and ulceration. The foot was in a marked degree of plantar flexion with some equinovarus deformity. On January 14, 1947, the Achilles tendon was lengthened and a biopsy of the left gastrocnemius muscle showed complete fibrosis. X-rays (Fig. 6) taken at this time revealed the equinovarus deformity of the foot associated with osteoporosis of the entire extremity.

CASE IV. B. S., a three year old Negro girl, was admitted to the Cook County Hospital on July 9, 1947, for a fracture of the middle third of the right femur. Both extremities were placed in Bryant's traction. The following morning, approximately fourteen hours after admission, it was noted that the left leg was cyanotic, swollen and painful. Traction was removed and reapplied. The third, fourth and fifth toes were definitely cyanotic. A lumbar sympathetic block was done without effect on the left lower extremity. The leg was then cooled with ice packs.

On July 11th the second sympathetic block was done. The extremity was removed from Bryant's traction and a posterior molded cast was applied to the right lower extremity. The temperature during this time rose to 100°F. rectally although the left foot remained cold, swollen and cyanotic. On July 10th papaverine hydrochloride, ¼ cc., was given every four hours. The ice pack was continued over the left lower extremity. That same evening the

foot appeared warmer and the color seemed better. The toenails were pink. Edema, however, remained.

Two weeks after admission it was found that there was an equinus deformity in the left foot with the left calf remaining thick, atrophic and hard. The equinus was corrected with a hinged cast and biopsy of the gastrocnemius muscle was done.

CASE V. A. P., aged five. This patient was admitted to the Cook County Hospital on August 10, 1944, for a fracture of the left femur. The child was placed in Bryant's traction for a period of two weeks. Because of superficial ulceration of the left leg the traction was removed and a cast was applied. The ulcer failed to heal and the left leg became markedly atrophic and thin. The cast was removed after several weeks and ambulation in a hip caliper was begun. During this period, however, the left lower extremity became atrophic, the foot being thin, fibrotic and deformed.

CASE VI. L. B., a five year old Negro girl, was admitted to the Cook County Hospital on June 24, 1945, with a fracture of the left leg. An open reduction was done and the child was discharged to the clinic. One month thereafter the cast of the left lower extremity was removed and it was found that the left heel was tender and the foot was in marked equinus. The left calf was markedly atrophic, dorsiflexion of the foot was impossible and an area of anesthesia was present over the lateral aspect of the foot. (Fig. 7.) An Achilles tenotomy was performed and the equinus of the left foot corrected.

On examination July 2, 1948, it was found that the left foot was at right angles to the calf. The ankle was markedly fibrosed and the toes were plantar flexed. Both dorsalis pedis and posterior tibial pulses were present.

CASE VII. D. G., a three year old Negro child, was hospitalized for fractures of the middle third of both femurs and placed in Bryant's traction. Three days later the left foot became cold and edematous. The dorsalis pedis pulsations remained palpable. Bullae developed over the dorsum of the foot and the skin became shiny. A large second degree slough of the mid-leg skin occurred after several weeks. Gradually, despite support with casts, an equinovarus deformity of the left foot developed. There was no voluntary movement of the left foot and hypesthesia was present over the upper leg.

FIG. 7. Photograph of deformity in late stage. Case VI. Marked circumferential atrophy of entire leg and foot are clearly demonstrated.

COMMENTS

Examination of our data reveals several findings that were common to all the case reports. First, every patient had sustained a femoral fracture although, significantly, not necessarily on the side which subsequently became involved with ischemic fibrosis. Second, in all instances the affected extremity had been subjected to compression in one form or another, while in all but one, elevation of the limb producing further impairment of arterial inflow had also been carried out. That arterial insufficiency existed in all the patients is supported by the early findings of absent pulsations in the feet, pallor and lowered skin temperatures, ecchymotic blebs, necrosis and other signs of nutritional disturbances.

There was also a certain amount of similarity in the various cases regarding the later manifestations of the condition, such as swelling, rise in skin temperature, induration of the calf muscles and insidious changes in

the nutrition of the nails and skin. Gradual foot deformity in the form of equinovarus was common in all cases, as well as marked atrophy of the calf musculature. In the three instances in which biopsies were performed replacement of muscle by fibrous tissue was uniformly found.

It is of interest that despite early treatment involving removal of all pressure from the extremity and the use of means to eliminate temporarily sympathetic tonus, the condition continued to progress to the point of fibrosis of the calf muscle with its associated contracture and deformity of the foot. In the treatment of these late complications surgical intervention was necessary in the form of tenotomy of the Achilles tendon, supplemented with braces or arthrodesis.

On the basis of our findings as well as those of other investigators certain tentative conclusions can be reached regarding the pathogenesis of ischemic fibrosis in young children. Since all but one of our cases had in common elevation of the extremity, Bryant's traction and the use of tight circular bandages, the possibility suggests itself that as a result of these procedures there was impairment of both superficial and deep arterial blood supply. Consequently, irreversible changes occurred both on the skin and in the deeper structures, particularly the muscles. At the same time, concomitant ischemia of local nervous tissue produced the areas of anesthesia and hypesthesia.

TREATMENT

The treatment of ischemic fibrosis should consist primarily of steps taken to prevent its inception. The most important of these is careful and continued observation of all cases of fractures of the femur in infants and children. For the first three or four days the state of the circulation in the toes and foot should be closely watched either by a responsible nurse, the intern or the resident, or even by a parent.

Changes in skin color, swelling of the foot or irritability of the patient are all findings which may have grave prognostic significance. At the first signs of their appearance the traction apparatus should be corrected, and the moleskin adhesive tape removed and replaced by Kirschner wire traction or by properly applied traction material.

Once ischemic fibrosis has been produced, the treatment is directed toward reducing the severity of the condition. This involves eliminating all sources of constriction, slight elevation of the limb, removal of heating elements such as lamps and cradles, and the use of paravertebral sympathetic procaine blocks and sympatholytic drugs. Although with such procedures it is generally possible to save the extremity, the ischemic aftereffects (i.e., the replacement fibrosis of the calf muscles, flexion deformity of the knee and foot, and deformity of the toes) are not prevented. If deformity does develop, operative procedures to correct these conditions should be used. (In equinus of the foot tenotomy of the Achilles tendon and wedge resection of the foot should be performed.) Also, other orthopedic procedures may have to be done, depending upon the deformity.

SUMMARY AND CONCLUSIONS

1. Seven cases of ischemic fibrosis of the lower extremities in young children are reported.

2. In each instance this complication followed a fracture of the femur treated with Bryant's traction or a cast.

3. In all cases but one treatment was instituted very early in the inception of the condition, but despite this, progressive and irreversible changes occurred resulting in a fibrotic limb with deformity.

4. For the late deformities, surgical intervention in the form of tenotomy or arthrodesis was considered necessary.

5. On the basis of the case reports it is suggested that ischemic fibrosis in young children is the result of an impairment in arterial blood flow which follows some of the procedures utilized in the treatment of the original fracture.

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A SIMPLE METHOD OF ANESTHESIA FOR MINOR SURGICAL PROCEDURES*

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A LITTLE used form of anesthesia will be presented which is employed in minor surgical and diagnostic procedures and which has given excellent results in my hands. This method of anesthesia has definite advantages over the present commonly used forms of anesthesia for these cases. The simplicity of administration and the compactness of the apparatus coupled with the lack of adverse effects on the patients should eventually put this form of anesthesia as first choice for the aforementioned category of patients. It has been my success with this anesthesia and apparatus (widely used in Great Britain) that has prompted me to present these facts about it.

A good many minor surgical procedures, either elective or emergency, occur during routine surgical practice. There are also many diagnostic procedures that patients must undergo. They all usually require some form of light anesthesia. The anesthesia must naturally suit the minor nature of the case, a fact that is too often forgotten today. Many of these patients are out patients or office patients and desire to return home after the physician is finished with them. Consequently these patients must receive a minor anesthetic that is easily administered and that leaves the body immediately with no after effects. The anesthetic should require little apparatus and should be able to be given easily in the office, accident ward or clinic. I believe that the anesthesia presented in this article fulfills all these premises splendidly.

There are at present three main forms of anesthesia for these minor cases, namely, local, intravenous with pentothal sodium and inhalation with nitrous oxide or vinethene.

In my experience local anesthesia is unsatisfactory in all cases except the smallest ones. Furthermore, many patients do not desire local anesthesia. Even if the procedure is relatively painless, many of the nervous patients will object and will have a fearful several minutes while the treatment is carried out. Finally, many of these procedures do not adapt themselves to local anesthesia.

Pentothal sodium is very popular with the patients in the operating room but they are not so happy when they come in for a minor procedure and then find themselves with a sensation of dizziness for the next several hours. This is always true with this drug, no matter how small the dose. Because of this there is a tendency to limit the amount of drug used with a resultant laryngospasm when pain is felt. This last fact is very true of pentothal sodium. There is no real analgesic effect with this drug and so the anesthesia must be kept deep to obliterate pain.

Vinethene is an expensive agent and is inflammable. It is a potent analgesic. It is not the most pleasant drug to take and causes much salivation. It cannot be used with electrical apparatus which is employed in many of these minor procedures.

Nitrous oxide is an excellent agent for these cases. Its only drawback is that it requires a large and expensive machine to administer it.

Trichlorethylene has the chemical formula CCl:CHCl and is a colorless liquid with a specific gravity of 1.47, a vapor density of 4.53 and a boiling point of 87°C. It is not inflammable and its vapor will not explode when mixed in any proportion with air. The liquid has an odor resembling that of chloroform but without its pungency. It is practically insoluble in water but will mix with any percentage of ether. Commonly, trichlorethylene is used for the dry cleaning of clothes and the degreasing of metals, but this grade is too impure to use in anesthesia. The especially purified form is known as trilene. This is stabilized by the addition of 0.01 per cent thymol and is colored in some cases with a blue dye.

The first report on the use of this drug on

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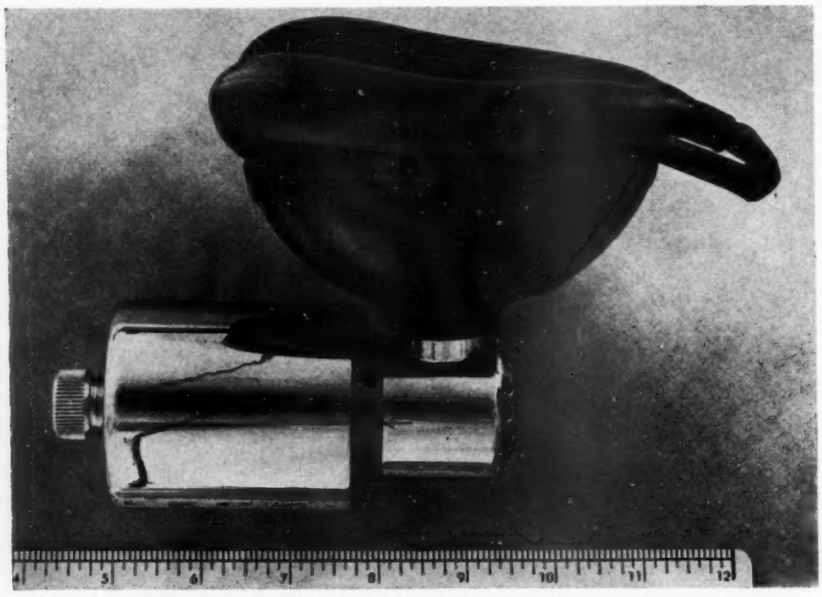

FIG. 1. The cyprane inhaler, lateral view.

humans was made in 1935 in the United States.[1] It was used in 300 minor surgical cases. After this its use was apparently dropped in the United States. The drug was later investigated extensively in Great Britain by Hewer.[2] Since then the use of the drug spread rapidly and now over one million administrations have been given in England. In this country it has never achieved any degree of popularity.

Trilene cannot be poured on a mask as it is not volatile enough; it must be vaporized by means of a gas flowing over it. It cannot be used in a closed circuit as it reacts with soda lime to produce dangerous by-products. The most common gas used for its vaporization is air. To this end many trilene inhalers have been devised. One of the simplest is the cyprane inhaler.* The original use of this inhaler was for self-administered obstetric anesthesia. (Fig. 1.)

The inhaler is small, portable and light in weight. It is about 6 inches long and weighs approximately ½ pound, and consists of a rubber face mask attached to a cylinder chamber that may be easily grasped in the hand. The chamber contains the agent which is put in through an opening at one end. There are openings in the other end which allow air to be drawn over the drug when the patient inhales through the mask. The flow of this air is to the patient only and the patient's exhalations are released through another valve. On the cylinder is a graduated scale controlling the amount of agent exposed, thus giving a crude measurement of the anesthesia or analgesia expected. Originally the scale was to be set and locked and then left with the maternity patient for self-administration of fixed strength of agent. As the inhaler is used for the cases described in this article, the lock is left open thus allowing for a variable control of anesthesia. In this way the patient may be induced with a mild dose, anesthetized with a stronger dose and then maintained with a varying amount of agent.

The cyprane inhaler with trilene was used in thirty cases with a high degree of success and satisfaction. It was naturally limited to minor procedures, especially on outpatients who desired to leave the hospital as soon as possible. The patients receiving trilene lost consciousness almost immediately and had analgesia very soon after the start of administration of the drug. Premedication at present consists solely of atropine sulfate in doses of 0.40 mg. muscularly. Narcotics and barbiturates were omitted as it was desired that these people be alert and awake as soon as possible. The atropine cut down on the excessive salivation that was seen to occur without this premedication. Analgesia was of a very high order with this; and although some patients seemed on the verge of moving, they did not move when pain was applied. Immediately upon cessation of administration of trilene the patient reacted. In from two to five minutes the patient was quite awake and

* Made by Cyprane, Ltd. Yorkshire, Great Britain. This may be purchased in North America.

very coherent, speaking clearly and intelligently. This is certainly not true with pentothal sodium in the short cases. None of the patients complained of any disagreeable odors or had any coughing during the induction period. All inductions were smooth. There was no laryngeal spasm. A good percentage of the cases showed an increase in blood pressure and pulse rate which was compatible with first stage anesthesia. There was no postanesthetic nausea or vomiting.

The cases in which this anesthesia was used are listed in the following categories: cystoscopy, six; cystoscopy and fulguration, six; repair of minor lacerations, seven; diagnostic tests (sternal puncture, etc.), five; D and C, two; I and D of abscess, three; and application of cast, one. Of course these cases were seen in surroundings where oxygen was available for administration with positive pressure and suction. Naturally no general anesthetic, no matter how short, should be undertaken without these two factors present and working.

CONCLUSIONS

The use of trilene as an anesthetic agent for minor cases and diagnostic procedures should in the future achieve some popularity. This should be especially true because of the simplicity of the apparatus that is used to administer it plus the very high analgesic power of this agent as compared with pentothal sodium, the most commonly used agent at present. In the short cases the cutting down of pain should be the prime factor rather than the complete unconsciousness of the patient. Trilene administered by the cyprane inhaler should prove useful in the office as well as the hospital.

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SPINAL ANESTHESIA FOR SPINAL OPERATIONS*

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PRESENTED herein is a series of sixty-six consecutive operations on the spine (explorations, laminectomies and fusions) in which spinal anesthesia was employed. The patients were all adults and all but one were men. None of the patients objected to spinal block. The advantage of spinal anesthesia here is in minimizing the untoward effects produced by the prone position. These are commonly seen during general anesthesia and are probably due to anesthetizing the upper half of the prone body. They usually consist of initial rises in blood pressure and in pulse and respiratory rates. There may also be cyanosis and shock. In addition, there was in these spinal cases unsurpassed muscular relaxation essential to these operations and an awake postoperative patient who could be put to bed in any position requested by the surgeon.

These were all single injection tetracaine (pontocaine) spinals. Some required no further analgesia while others were completed with a single intravenous injection of 1/8 gr. of morphine, pentothal sedation (small dose without loss of consciousness), local injection, pentothal anesthesia or additional subarachnoid injections. The six groups are presented numerically in Table 1.

TABLE 1

Supplementary Analgesia	No. of Cases
No other analgesia required	19
Morphine injection only	21
Pentothal sedation	7
Local injection	1
Pentothal anesthesia	10
Additional spinal injections	8

In 70 per cent or better than two of three cases nothing at all, or only a little sedation, was required despite the fact that the incision was generally made nearly half an hour after the spinal injection. The importance of adequate dosage is shown by the observation that 58 per cent of patients who were given less than 17 mg. of tetracaine could be taken care of without general or additional spinal anesthesia, while the figure for those receiving more than 17 mg. was 78 per cent. Some cases in which pentothal or more spinal was given could have been finished with local. Sometimes pain is produced by direct stimulation of a spinal nerve root; it is not necessary to put the patient to sleep for this. It is only momentary and is not severe and may even be a help to the surgeon as a means of identification.

TABLE II
AVERAGE VALUES AND RANGES IN THE SIXTY-SIX REPORTED CASES

	Low	High	Average
Age of patient (yr.)	21	54	33.6
Operating time (min.)	70	225	140.1
Time from spinal to incision (min.)	20	45	28.1
Anesthesia time (min.)	105	255	177.2
Dose of tetracaine (mg.)	14	20	17.2

TABLE III
DOSES OF TETRACAINE (PONTOCAINE) ADMINISTERED IN THE SIXTY-SIX CASES

Milligrams	No. of Cases
14	1
15	2
15.5	1
16	7
16.5	2
17	17
17.5	14
18	18
18.5	3
20	1

On one occasion oil previously injected for myelography was seen to flow from the spinal needle. It was allowed to escape until the fluid became clearer and the injection was made; anesthesia was good and there were no complications. In the cases requiring pentothal, the number of those of longer than average duration exceeded the total of the shorter ones in a ratio of 2.3:1.

Ranges and average values for dose, age and

* From the Veterans Administration Hospital, Lincoln, Neb.

duration are given in Table II. The distribution of doses of tetracaine (pontocaine) is shown in Table III.

No marked variations in blood pressure, pulse or respiration occurred in the series. Supplementary anesthesia was easily accomplished when required. Nitrous oxide was not usually added to the pentothal. Tracheal intubation (which was invariably done when general anesthesia was used from the start, without spinal block) was not employed in these cases. Supplementary intrathecal injections (used only at the start of the series) were done by the surgeon under the direction of the anesthesiologist through the exposed dura and consisted of 50 mg. of procaine dissolved in 2 cc. of spinal fluid. Anesthesia and recovery were uneventful and offered a pleasing change from general anesthesia. It must be emphasized that these operations are all performed on the lumbar spine: this is surely a rare opportunity for the use of spinal anesthesia.

PATIENTS with gastrojejunocolic fistula pass large, bulky and partly undigested stools soon after eating. They have excessive hunger and hypoglycemia (due to the dumping syndrome) and they are apt to lose weight persistently. Feces may regurgitate into the stomach and the frequent belching present has a characteristic fecal odor. Diarrhea and enteritis occur in some patients; others have actual fecal vomiting. X-rays following barium meal or barium enema will ascertain the diagnosis. (*Richard A. Leonardo, M.D.*)

MULTIPLE MESOTHELIAL CYSTS OF THE PERITONEUM*

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Cleveland, Ohio *Bethesda, Maryland* *Cleveland, Ohio*

EWING[1] has classified cystic intraperitoneal tumors as follows: (1) chylous representing lymphangiomas which may be large or small, multiple or solitary; (2) enteric which are also large or small, multiple or solitary and occur principally along the omphalomesenteric duct (especially in the region of a Meckel diverticulum); (3) nephrogenic, usually of large size arising from remnants of the wolffian body and found in the pelvic peritoneum of adult women; and (4) dermoid cysts.

Willis,[2] however, has stated that "primary" peritoneal neoplasms are usually metastatic tumors from other organs. Clinically this observation is true. Frequently the source of cystic implants is a benign or malignant pseudomucinous ovarian cyst. This gives rise to the well recognized condition pseudomyxoma peritonaei in which the peritoneum is studded with innumerable cysts containing a refractile, mucoid, gelatinous fluid. Another less frequent source for pseudomyxoma peritonaei is a ruptured mucocele of the vermiform appendix. Gastrointestinal carcinomas of the colloid or mucinous type may manifest themselves by multiple cystic peritoneal implants. Multiple cysts of the serosal covering of the female internal genitalia are not infrequently observed macroscopically They are usually no larger than 1 mm. in cross diameters and are found microscopically to be comprised of an inner lining of mesothelial cells or, less frequently, cells of the Walthard type or columnar cells with a smooth muscle wall representing embryologic remnants of the müllerian duct.

Recently an instance of multiple cysts of the peritoneum was observed at the Cleveland Clinic. Even after careful exploration no primary source for their occurrence could be found. Recognition of a primary, diffuse, cystic condition of the peritoneum, which may simulate carcinomatosis, as well as the pathologic rarity of the lesion merits the report of this case.

CASE REPORT

A twenty-five year old colored woman, gravida 0, was admitted to the Cleveland Clinic Hospital on January 1, 1952, with the chief complaints of nausea, vomiting and lower abdominal cramping pain associated with menstruation. This had been present since the menarche. In the past six months there had been a 16 pound weight loss. The remainder of the history was negative. There was no history of foreign substances having been introduced into the peritoneal cavity and there had been no previous operations.

The patient appeared thin and chronically ill. Blood pressure was 102/60 mm. Hg and the temperature was 98.6°F. The abdomen was soft, flat, non-tender and without palpable masses; no fluid was present. Pelvic examination revealed a firm, moderately fixed, non-tender mass in the upper one-third of the rectovaginal septum. It was estimated to be 3 by 3 by 1 cm. The cervix was nulliparous and clean. The uterus was of normal size and separate from the previously described mass. To the left of the uterus there was a firm, somewhat movable 6 cm. mass. The blood hemoglobin was 12 gm. and the leukocyte count was 4,350 with a normal differential. Urinalysis was negative. A barium enema and chest x-ray were normal. A urogram demonstrated only extravesicle pressure.

Biopsy of the rectovaginal septum revealed endometriosis. Because of this and the presence of an unexplained mass to the left of the uterus an exploratory laparotomy was performed. At operation the omentum majus, especially in its inferior portion, was largely replaced by innumerable pea-sized cysts containing a clear, watery fluid. (Fig. 1.) The surface of the uterus, tubes, small intestine, appendix, descending colon and bladder were similarly involved. These cysts were encountered in the upper portion of the omentum majus and peritoneal cavity but were not as numerous as in the lower abdomen.

* From the Cleveland Clinic and the Frank E. Bunts Educational Institute, Cleveland, O.

The mass to the left of the uterus, an intraligamentous leiomyoma approximately 6 cm. in diameter, was removed. The ovaries were of normal size and contained numerous small cysts, grossly of the follicular type. Wedge biopsies of both ovaries were performed. The posterior aspect of the uterus and broad ligaments were adherent to the sigmoid colon and pelvic peritoneum due to the presence of numerous cysts with slight reactive fibrosis. The tubes were normal. General exploration of the abdominal viscera revealed no other abnormalities or pathologic changes.

The specimen consisted of an irregularly shaped segment of omentum measuring 6 by 3 by 1.5 cm. Much of the omental tissue was replaced by numerous, closely placed, thin-walled, translucent, amber-colored, unilocular cysts varying in size from 1 to 6 mm in cross diameters. Puncture of the cysts released a clear, watery fluid (non-mucinous)

Also submitted was a firm nodule measuring 5.5 cm. in cross diameters. The cut surface demonstrated whorled dense white tissue.

Two segments of ovarian tissue, each measuring 0.5 by 0.5 by 0.25 cm., were submitted. Except for the presence of 1.0 mm. sized cysts containing clear fluid, the tissue was not unusual.

Microscopically, sections of omentum stained with hematoxylin, eosin and methylene blue revealed replacement of omental adipose tissue by numerous cysts varying in size from 150 microns to several millimeters in diameter. (Figs. 2A and B.) Many of the cysts were lined by flat, dark-staining cells of indefinite character. However, in areas the cells were distinctly round to cuboidal with regular dark-staining nuclei. The cystic spaces contained a finely granular acidophilic coagulum. No definite cyst walls were apparent and the cystic spaces were separated by a stroma of fibrous, myxomatous and adipose tissue which contained a moderate number of engorged capillaries and an occasional thick-walled artery and vein. In areas this stroma was infiltrated by lymphocytes, plasma cells and occasional neutrophils.

Sections of ovaries revealed normal structure. Several small cysts of the follicular type were present.

Section of the intraligamentous nodule revealed interlacing bundles of smooth muscle cells with moderate number of thin-walled blood vessels and scant amount of connective tissue.

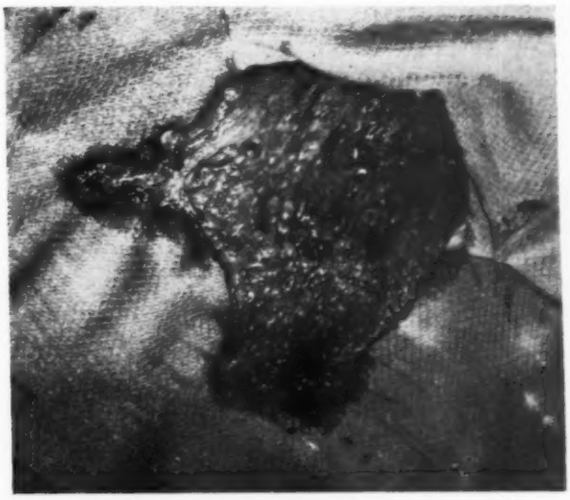


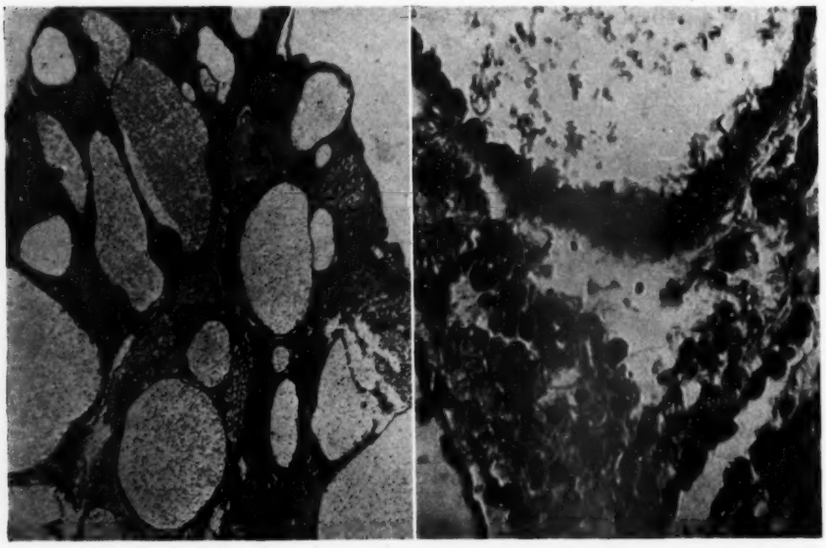
FIG. 1. Multiple cysts in omentum at time of laparotomy.

The diagnosis was (1) multiple mesothelial cysts of the omentum and peritoneum, (2) follicular cysts of ovaries and (3) leiomyoma (intraligamentous).

COMMENT

There have been few similar cases of primary multiple mesothelial cystic disease of the peritoneum. Plaut[3] in 1928 reported the incidental laparotomy finding of several large intraperitoneal and omental cysts in a young woman. Histologically, the lining cells were considered epithelial in nature although they were believed to be of peritoneal origin. Plaut called the condition "benign cystic serosa epithelioma of the peritoneum." No photomicrographs were included in his report but the description of the cell type is similar to that encountered in the case reported herein. More recently, Lord[4] has reported a case in which innumerable thin-walled peritoneal cysts occurred in the right lower quadrant of a fifty-three year old woman. These produced a palpable mass as well as the roentgenographic appearance of carcinoma of the cecum. Plaut reviewed the microscopic sections and concluded that the cysts were identical with those encountered in his previously reported case.

Histologically, the lining cells in our case are most compatible with mesothelial cells. This is in keeping also with the mesothelial identity of the peritoneal cell.[5] Thus we believe that a more appropriate name for the condition



2A 2B

FIG. 2. A, low power photomicrograph of cysts (× 30); B, high power photomicrograph demonstrating lining cells of cysts—most compatible with mesothelial origin (× 460).

is multiple mesothelial cysts of the peritoneum. The noticeable number and close proximity of the cysts tends to indicate an hamartomatous origin rather than true neoplastic derivation. The absence of previous operative procedures or other discernible primary cause tends to support this contention. The cyst type apparently does not clearly fit into the classification proposed by Ewing as histologic evidence, for the lymphatic, enteric, nephrogenic or teratomatous derivation is lacking.

It seems unlikely that our patient's complaints can be explained by the presence of these many intraperitoneal cysts. Much of the symptomatology may be accounted for by the presence of malnutrition and endometriosis. What effect the peritoneal cysts will have upon the patient's general condition remains problematic. Both previously reported cases (Plaut and Lord) followed a benign clinical course. Plaut also has inferred that other reported cases of peritoneal cysts, although considered to be of lymphatic or other derivation, similarly have been benign.

It should be emphasized that the majority of instances of multiple cysts will be due to the presence of a primary neoplasm of either the ovary or gastrointestinal tract.

CONCLUSIONS

A case of multiple intraperitoneal mesothelial cysts is presented. The recognition of such a condition, albeit rare, is of clinical importance at the time of laparotomy since the condition may simulate secondary carcinomatosis. A helpful aid in the differentiation of the primary mesothelial cyst from that due to secondary carcinoma is the clear, watery, cystic content as opposed to the more mucoid fluid encountered in the latter.

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RECURRENT APPENDICITIS IN EACH TRIMESTER OF PREGNANCY

WITH A CASE REPORT IN EACH TRIMESTER

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APPENDICITIS is one of the most treacherous of all diseases. Its association with pregnancy does not relieve the situation in any way; in fact, it appears that the pregnant woman is more susceptible to recurrent appendicitis. It is impossible to foretell whether a recurrent acute process in the appendix will subside promptly or progress.

Until recently appendicitis associated with pregnancy was regarded as something of a surgical curiosity. In 1905 Kelly wrote that the reported cases of appendicitis in pregnancy were too few to warrant any definite conclusions. In 1908 Renvoll recorded twenty-five cases.

The reason appendicitis is found relatively frequent in pregnancy is because it is preeminently a disease of the child-bearing age with its highest incidence between twenty and thirty years of age. The frequency is estimated to be between 1 and 2½ per cent. Parity plays no part.

The woman who has had an attack of appendicitis is very likely to have it again during her pregnancy. Over 50 per cent give a history of previous attacks.

According to Maes, recurrent appendicitis is unfavorably influenced by menstruation, and the menstrual cycle continues to exert its effect on the appendiceal disease even during gestation when the menses are suppressed. One can assume then that pregnancy, which introduces altered abdominal relations and altered constitutional states, should have an even more exciting effect upon latent disease. Constipation, which is usual during pregnancy, and the engorgement of the pelvic and hemorrhoidal veins, which is physiologic, also have an effect.

In recurrent appendicitis in the first trimester the stage of gestation is important. Recurrent appendicitis becomes increasingly infrequent and increasingly more severe as the stage of pregnancy advances. One chief reason for delayed surgery is the failure to recognize the condition. The morning sickness and general malaise of early gestation are a source of error.

In this stage, however, bimanual examination is helpful. In later stages the adnexal organs are out of reach. This is especially important in the differential diagnosis of ectopic pregnancy.

In the *first trimester* operation is seldom difficult or complicated. The danger of abortion varies directly with the seriousness of the disease and the manipulation of the uterus. If abortion does occur, there is a danger of infection because of the gaping and thrombosed sinuses in the uterus which form channels of spread.

Second trimester: The majority of the cases of recurrent appendicitis in pregnancy occur in the first six months, especially in the second trimester when the appendix becomes transformed from a pelvic to an abdominal organ. Baer, Reis and Arens have shown by x-ray studies that the appendix undergoes a progressive displacement upward after the third month of pregnancy and reaches the level of the iliac crest at the end of the sixth month. The appendix undergoes counterclockwise rotation, which makes for anatomic and physiologic unrest. The situation is more aggravated if because of some previous inflammatory attacks the appendix has become adherent to some of the pelvic structures.

In this stage fetal movements may cause pain and interfere with an early diagnosis. Because the uterus normally rotates to the right and so may compress the ureter where it crosses the pelvic brim, a resulting pyelitis may be important in the differential diagnosis. Ectopic pregnancy may be a factor in the differential diagnosis in this stage; however, it is more important in the first trimester. Twisted

ovarian cysts and fibroids are often important in this stage.

Usually the operation is a little more difficult in this stage as compared to the first trimester period. The large uterus renders it difficult to expose the parts well at times and may interfere with proper drainage.

The more severe the infection and acute the process and the more manipulation of organs, especially the uterus, the higher the incidence of miscarriage.

Recurrent appendicitis in the *third trimester* of pregnancy is frequently very difficult and complicated to handle. If an acute process here is not surgically treated, Maes states the rule is for rapid spread, rupture and a diffuse spreading peritonitis with little tendency to localize and form an abscess.

If the appendix lies high in the abdomen, there may be no loops of bowel to limit extension of infection. Pus can spread to the pelvis only along the smooth uterine wall. The uterus tends to crowd the protecting omentum out of the way; and if the uterine wall forms part of the abscess, fetal movements and uterine contractions may destroy whatever localization may be present.

In this period with the localized tenderness higher, upper abdominal disease has to be differentiated. Muscle spasm may be difficult to elicit because of the attenuation and thinning of the abdominal muscles. Pain resulting from fetal movements in this stage and from the onset of labor may be a problem in differential diagnosis. Symptoms of eclampsia and pyelitis may be confusing here as in the second trimester.

Laboratory work is often not very helpful in the diagnosis of recurrent appendicitis. There is a physiologic leukocytosis. Any white blood count under 12,000 is not very useful. An increase in polymorphonuclears may be helpful. The sedimentation rate is not useful. Albuminuria and pyuria, of course, are important factors in eclampsia.

Ileus associated with recurrent appendicitis during pregnancy usually occurs at term or in the first few days of the puerperium. The violent alterations which occur during labor and immediately after delivery have a deleterious effect on the pre-existing disease.

The incidence of premature labor is high when surgery is performed. However, this also depends on the severity of the infection and the manipulation necessary to remove the appendix or drain the abscess. It must be remembered that perhaps a larger percentage of patients would miscarry from the disease process if not operated upon. Some have advised cesarean section followed by the appendectomy in this stage, or vice versa. However, most authorities agree that cesarean section because of appendicitis is rarely justified.

CASE REPORTS

Recurrent Appendicitis in the First Trimester of Pregnancy

Mrs. E. H., age thirty-six, entered the hospital on March 15 1947, with a complaint of abdominal pain of three days' duration. Pain began in the umbilical region, remained steady and dull but on the following day radiated to the right lower quadrant of the abdomen. There was some nausea but no vomiting or diarrhea and no urinary symptoms. The patient had had no previous operations. She had been pregnant twice, six and three years previously, and the second time she was delivered of twins. Her last menstrual period was on January 1, 1947. She had had three similar but milder attacks of pain in the past year.

Examination revealed a moderately obese female with a fever of 99.2°F. and a pulse rate of 104. The abdomen was slightly distended, slightly rigid in both lower quadrants, and tenderness and rebound tenderness were present on the right lower quadrant. On pelvic and rectal examination tenderness was noted on the right and a fullness on the left.

The urinalysis was entirely negative. Red blood cell count was 4,920,000, hemoglobin 78 per cent, 12.6 gm., white blood cells 12,650, 87 per cent polymorphonuclears, 11 lymphocytes, 2 monocytes and 1 stab form. The Wassermann test was negative.

At surgery the appendix lay retrocecal, was elongated, dilated in the distal third and bound to the posterior aspect of the cecum by marked adhesions. There was a fibrinous exudate on the surface. The left ovary was involved in a large dermoid cyst on a long twisted pedicle. The uterus was enlarged to the size of a two-month pregnancy. The cyst and appendix were removed through a lower midline incision. Pathologic examination of the appendix revealed an inflammatory exudate in the lumen.

Postoperatively intravenous glucose and

demerol were given. The patient made an uneventful recovery and was dismissed on the seventh postoperative day. She later was delivered of a normal baby at full term.

Recurrent Appendicitis in the Second Trimester of Pregnancy

Mrs. F. P., age twenty-six, entered the hospital January 17, 1949, with a history of abdominal pain of one day's duration. The day before admission right lower quadrant abdominal pain, nausea and vomiting developed. The patient had taken a laxative the night before and had four loose bowel movements during the night. The pain was dull in nature but persistent and became gradually worse. There were no urinary symptoms.

The patient had to spend the first six weeks in bed during her pregnancy two years previously because of abdominal pains. Following this she had three mild attacks of right lower quadrant abdominal pains at six-month intervals; the last was six months before admission. She had had no previous operations. Her last menstrual period was August 12, 1948.

Examination revealed an acutely ill female with a fever of 100.2°F. and pulse rate of 98. The uterus was enlarged to the umbilicus. Slight rigidity was present in the right lower quadrant. Marked tenderness and slight rebound tenderness were present in the right lower quadrant. Rectally there was tenderness high on the right.

The urinalysis was entirely normal. The red blood cell count was 4,250,000, hemoglobin 76.5 per cent, 12.3 gm., white blood cells 17,400, 78 polymorphonuclears, 17 lymphocytes, 4 monocytes and 8 stab forms.

At surgery a marked increase was noted in the peritoneal fluid which was cloudy in appearance. A culture of the fluid was taken which was negative. The cecum, terminal ileum, right tube and ovary were markedly inflamed. The appendix lay retrocecal and was acutely inflamed with a fibrinous exudate on the surface. There was marked edema of the mesoappendix and base of the cecum. The appendix was delivered through a McBurney incision. Pathologic report of the appendix was acute suppurative appendicitis.

Postoperative treatment consisted of 5 mg. of progesterone daily, morphine relatively frequent and 100,000 units of penicillin every three hours. She made a very uneventful recovery and was dismissed on the sixth postoperative day. She had a normal delivery near term.

Recurrent Appendicitis in the Third Trimester of Pregnancy

Mrs. R. U., age thirty-two, a full term multipara, entered the hospital on March 17, 1947, having intermittent abdominal pains every five minutes. She had had two previous normal pregnancies three and five years previously. She had had no operations. Progress of labor was rapid with spontaneous delivery of a normal infant from R.O.A. with a small first degree laceration and no excessive bleeding.

During the first twenty-four hours postpartum the patient complained of intermittent generalized abdominal pains, anorexia and insomnia. Pain developed in the right lower quadrant and the abdomen began to be distended. Distention progressed and no peristalsis was noted. There was slight rigidity and mild tenderness in the right lower quadrant. After six hours the patient became nauseated but did not vomit. A flat x-ray plate of the abdomen revealed gas in the small and large bowel.

The urinalysis was normal. Red blood cell count was 4,010,000, hemoglobin 77 per cent, white blood cells 13,200, 78 per cent polymorphonuclears, 18 per cent lymphocytes, 2 per cent monocytes, 1 per cent eosinophils and 16 per cent stab forms. The patient's temperature was 101°F. and pulse rate 112. Red blood cells and hemoglobin remained about the same but the white blood cells rose to 17,100, with the same differential. Enemas, Wangensteen and Miller-Abbott suction were ineffective in relieving the distention. A diagnosis of paralytic ileus and acute appendicitis was made. Intravenous glucose in saline and whole blood was given and a laparotomy (right rectus incision) was performed. At surgery the small and large bowels were markedly distended, especially the cecum. No peristalsis was noted. The appendix lay retrocecal, and was moderately dilated and acutely inflamed with a fibrinous exudate on the surface. Jackson's veil was present on the cecum. The appendix was removed and cecostomy performed. Pathologic report of the appendix was acute recurrent appendicitis.

Postoperative treatment consisted of employing Miller-Abbott tube suction and admin-

istering transfusions, intravenous glucose, penicillin and sedation. Slow, steady progress was made and the patient was dismissed in good condition on the seventeenth postoperative day. The cecostomy wound had practically stopped draining. Further convalescence was satisfactory and the patient made a complete recovery.

CONCLUSIONS

1. Recurrent appendicitis is relatively frequent in pregnancy; and as the pregnancy advances, the attacks become increasingly more severe, with more difficulty in diagnosis, and the surgical procedure more difficult.

2. Appendicitis is likely to recur in pregnancy if there has been a previous attack.

3. An interval appendectomy, without undue delay, is indicated in those cases in which there has been definite recurrent attacks.

4. In an acute process an appendectomy should be performed as soon as feasible. If frank pus is present and the appendix is not readily accessible, drainage alone should be performed. There should be minimal manipulation of pelvic organs.

5. In general, the McBurney type of incision is preferred to combat the progressive strain on the abdominal wall and to limit the spread of infection.

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Modern Operative Technics

No. 10

TRANSECTION OF A CORONARY ARTERY DURING THE COURSE OF MITRAL VALVULAR COMMISSUROTOMY*

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TRANSECTION of the circumflex branch of the left coronary artery incident to the performance of mitral valvular commissurotomy is reported for the first time in the world literature. Its situation in the left portion of the atrioventricular groove, inferior to the great coronary sinus and beneath the left auricle, makes this vessel especially vulnerable to "blind" incision during intracardiac surgery.

Such transection is a very real hazard and merits detailed description here because of the calamity inherent in its occurrence and the fact that this danger will tend to increase in direct proportion to the number of times commissurotomy shall have been performed on patients requiring this type of surgery of the mitral valve. Further, we believe all possible pitfalls surgically attendant with the procedure should be pointed out not only for the novitiate in intracardiac surgery but also for those well skilled in these technics but who, fortunately and fortuitously, have not met with the disastrous circumstance of severing the coronary vessel while performing this comparatively innocuous operation. It must be emphasized that incision of the coronary artery can and does occur unknown at the time to the operator despite his utmost precautions to avoid the vital vessel. Finally, the clinical picture associated with coronary transection deserves elucidation.

This unfortunate complication has occurred only twice during the course of 282 mitral valvular commissurotomies (0.7 per cent) performed at the Hahnemann Hospital.

CASE REPORT

S. L. (No. 55722), a twenty-nine year old white male machine tool-cutter, sought cardiac surgery in May, 1951, because of relentless, increasingly severe congestive heart failure completely disallowing any physical activity for two months prior to hospital admission.

His pertinent medical history began at the age of fourteen years when he had acute rheumatic fever featured by aching of both knees (especially the left) and also the left foot in the region of the os calcis. No further difficulty ensued until 1941 when he had "intestinal flu" and was digitalized at that time for reasons obscure to us. Several years later he had complaints of epigastric fulness and tightness. Eighteen months prior to this admission he experienced two episodes of near syncope. Three months later he noticed exertional dyspnea for the first time. Six months prior to entering Hahnemann Hospital a cough productive of moderate amounts of white, frothy mucus appeared. At no time did he have hemoptysis. Subsequently, by four months, easy fatigability and exertional dyspnea were pronounced and bilateral leg edema appeared with the least physical activity, i. e., walking only a few steps. There were no other complaints except some looseness of the stools for six months prior to entry into the hospital. Medication had consisted of 0.1 gm. daily of digitalis folia, sporadic mercurial diuretic therapy, every three or four weeks, and a 1.0 gm. salt diet.

Childhood illnesses before the age of thirteen included measles, chickenpox, pertussis and "pneumonia" five times. At one time he had an undiagnosed skin lesion of the forehead and left hip with recurrent nocturnal itching. Severe sumac poisoning was experienced in 1938. A tumor of the left breast was removed in 1949. There were no accidents, fractures or dislocations. Venereal infection was denied.

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The patient was rejected by the Army in 1939 and 1940 because of heart disease. His normal weight was 157 pounds as compared to admission weight of 144; he was 6 feet tall. He did not use tobacco or alcohol.

Negative answers were obtained in response to queries regarding familial history of tuberculosis, cancer, diabetes, kidney disease, mental illnesses and allergy. His mother, age forty-eight, was living and well while his father had died at the age of forty-four of heart disease. There were three sisters between the ages of fifteen and twenty-seven, all living and well.

Physical examination revealed a normally developed, slender, hyposthenic white male with pallid complexion. The skin temperature was lower on the left anterior hemithorax (probably due to the surgery performed on the tumor of the breast) than on the right. There was no lymphadenopathy and the remaining breast was normal. Palpation and inspection of the thyroid revealed no abnormalities.

Cardiac examination showed rather marked enlargement to the left as evidenced by displacement of the apex impulse laterally to the left anterior axillary line and downward to the sixth interspace. In the mitral area there was a grade 3, harsh systolic murmur. In diastole there was a third sound of low pitch which initiated a low pitched, grade 3, decrescendo diastolic murmur. This adventitious sound was interpreted as representing an atypical gallop rhythm. P_2 was accentuated 2 plus and was split. Atrial fibrillation was the arrhythmia, with apex rate of 78 per minute. Blood pressure was 100/70 mm. Hg (L) semi-recumbent and 118/80 (R).

The lungs were clear on auscultation and percussion. There was no liver or splenic enlargement. No pedal or pretibial edema was present. Peripheral arterial pulses were palpable readily.

Atrial fibrillation, right ventricular hypertrophy-strain pattern and digitalis effect were the features seen on electrocardiogram.

The patient was considered to be an undesirable candidate for mitral valvular commissurotomy for the following reasons: (1) marked over-all cardiac enlargement, (2) left ventricular enlargement, (3) some degree of mitral insufficiency and (4) atypical gallop rhythm.[2] He was discharged after institution of an intensive antifailure regimen to which he had responded favorably during his period of hospitalization.

Five months later, after convalescence at home, he was readmitted. Re-evaluation disclosed he had dyspnea only on stair-climbing, with no dyspnea on limited physical exertion otherwise, no nocturnal distress, complete subsidence of cough and no return of extremity edema. He had gone from 133 to 150 pounds in weight, apparently a dry tissue increase. The cardiac auscultatory status remained unchanged. In view of the generally improved status operation at this time appeared feasible.

Laboratory studies initially showed the following: red blood cells, 4,670,000; hemoglobin, 14.4 gm.; hematocrit, 49; sedimentation rate, Westergren 23 mm./hr.; white blood cells, 6,850 (polymorphonuclears 74 per cent, monocytes 1 per cent, lymphocytes 24 per cent, eosinophils 1 per cent); urinalysis unremarkable; prothrombin level 50 per cent; total serum proteins 7.9 (albumin 3.7, globulin 4.2). Other chemistry tests were normal and serologic tests negative.

At operation the patient was anesthetized, utilizing the principles of procedure as reported.[9] With the patient in the right lateral position, the usual curved posterolateral incision was made around the left scapula. Bleeding points were clamped and coagulated. The left fifth intercostal space was opened widely. The lung was mobilized partially from the chest wall because of adhesions and then it was compressed posteriorly.

The pericardium was opened in its posterior and upper portion parallel to the left phrenic nerve and just behind it. The auricle (auricular appendage) was seen to be very large and on palpation there was a systolic thrill with each ventricular contraction. This we deem pathognomonic of mitral insufficiency. However, there was also a diastolic thrill palpable over the anterior apex of the left ventricle, this being pathognomonic of mitral stenosis. The clinical diagnosis was confirmed by this direct technic.

Two purse-string ligatures of braided No. 2 silk on atraumatic needles were placed about the base of the auricle. A Satinsky clamp was applied across its middle and a 2 cm. incision was made in its tip. The doubly gloved right index finger of the operator then was inserted through the opening into the left atrium (auricle) and immediately it came upon a

heavily calcified mitral valve.[8] This was found to be open posteriorly in a pear-shaped fashion or tear-drop shape so that there was regurgitation with each contraction. The opening was just big enough to engage the fingertip. Digital pressure was completely ineffective in opening the valve. Because of that a right-sided O'Neill guillotine was applied between the two gloves on the index finger as the finger was withdrawn partially from within the cardiac chamber.

After placing the instrument on the finger the finger was sunk more deeply within the heart and the guillotine was opened. It was engaged upon the anterolateral commissure of the valve. This was cut by two closures of the guillotine but the actual separation of the valve, which was completely calcified, was not effected adequately by these maneuvers. However, the opening was large enough so the finger could go through into the left ventricle without too snug a fit.

If anything, the incompetency of the mitral valve was increased rather than decreased by this opening of the commissures. At this point it seemed advisable and expedient to apply an intermittently occluding graft over the ventricular orifice. Accordingly, a pericardial sling was fashioned to obviate the ill effects of the surgically enhanced mitral insufficiency. The details of that procedure, which incidentally was singularly successful, will be reported elsewhere since they are not pertinent to the primary purpose of this report. This in place, the finger was reinserted well within the heart cavity and the right-sided guillotine was engaged again upon the anterolateral commissure.

By five or six closures of that instrument, the heavy calcification of the anterior commissure was divided completely—practically, we believed, to the ventricular wall. Finally, it was possible to mobilize both lips and to have them wobble around freely without any immediate attachment to each other. It was the operator's thought that the fit of the valve would be better, the graft would take care of any residual leak and the patient's entire valvular status would be improved.

However, just about this time a very peculiar rhythm developed, with a very rapid rate and quite weak contractions (ventricular tachycardia?). Consequently, it was apparent there was appreciably diminished cardiac output.

The finger was withdrawn from the heart, the purse-string ligatures and the appendage were tied and the cut end was oversewn. The pleura was flushed with saline and was drained with a No. 26 urethral catheter inserted through a stab wound in the left eighth interspace at the posterior axillary line. Rib closure was by approximation using double No. 3 chromic catgut pericostally. Musculofascial layers of the chest wall were closed by continuous No. 1 chromic catgut. Skin closure was with continuous wire.

The patient was in very poor condition at the time he was returned to his bed but his pulse was palpable and his blood pressure was obtainable at 70 mm. Hg systolic.

Upon return from the operating room the patient became increasingly restless and writhed as though in extreme pain despite the customary sedation. He remained unconscious but showed no signs of motor affection. Lateral, divergent strabismus was present together with slight lateral nystagmus.

Medium crepitant rales were audible over the left chest anteriorly while the right chest exhibited no adventitious sounds. Heart sounds were inaudible, presumably because of their masking by the pulmonary sounds. One or two sounds occurred at a level of 82 mm. Hg (L) and probably represented systolic blood pressure. Pulses were not obtainable. Venous pressure on inspection did not seem elevated remarkably. Although the skin was abnormally cool, it was normally moist. Pallor was marked. This status prevailed for approximately forty minutes following the conclusion of surgery.

Suddenly the patient became violently agitated and hyperkinetic, exceedingly hyperpneic, cast his head backward in opisthotonic extension and deviated slightly to the right. The gaze became a conjugate deviation to the right in an upward and outward direction. A dramatic change from extreme pallor to immediate and intense cyanosis preceded only momentarily the abrupt cessation of respiration. Cardiac action was not detectable. Apparently death transpired within this three-minute period just described.

Acute anemic anoxia affecting primarily the medial longitudinal fasciculus, facial nuclei and fibers of the sixth cranial nerve would seem to have been responsible for the symptoms described. These simulate the pontile syndrome of Foville,[1] differing from it only in the fact that pyramidal involvement causing contralateral hemiplegia was lacking. Histopatho-

logic study of our specimen is in process and will be reported elsewhere. (Figs. 1 to 3.)

DIFFERENTIAL DIAGNOSIS

An acute, dramatic episode such as this following mitral valvular commissurotomy brings to mind a peculiarly unique group of entities from the standpoint of emergency differential diagnosis. In order of their simulation of the terminal clinical picture described (and not necessarily in the order of their frequency, by any means) we list them as follows: (1) rupture of a ventricle, (2) acute cardiac dilatation, (3) the syndrome of surgically induced, dynamically significant mitral insufficiency, (4) acute pericarditis with appreciable pericardial effusion, (5) acute myocardial infarction, (6) pulmonary embolism,

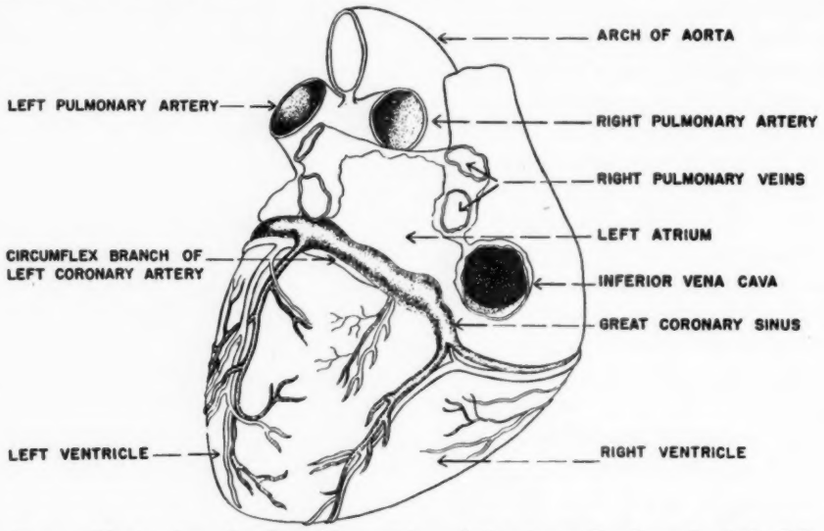

FIG. 1. Illustration of vulnerable position of the circumflex branch of the left coronary artery, located in the left portion of the atrioventricular groove, inferior to the great coronary sinus and beneath the left auricle. At the head of the arrow indicating the position of the circumflex branch is the site of transection described in this report.

2 3

FIG. 2. Line AB represents (usual) commissurotomy incision. Line BC indicates undesired extension which resulted in transection of the circumflex branch of the left coronary artery from an intracardiac approach. This is a photograph of the autopsy specimen.

FIG. 3. Line AB shows the inverted cut ends of the circumflex branch of the left coronary artery. Line CD again illustrates the extent of the unintentional incision.

(7) ventricular fibrillation and (8) complete heart block progressing to cardiac standstill.

Rupture of a Cardiac Chamber. The puzzlingly late appearance of the symptoms of transection of the circumflex branch of the left coronary artery (forty-five minutes after the conclusion of the operative procedure) resembled nothing so much as the clinical picture produced by spontaneous rupture of the left ventricle following acute myocardial infarction. This entity, too, is observed rarely in clinical practice but was identified at the bedside by one of us (F. C. M.[7]). In that instance there were: (1) general acute hypertonicity of the muscles universally, (2) hyperextension of the head, (3) lateral conjugate strabismus, (4) instantaneous cyanosis, (5) cardiac asystole and (6) abrupt cessation of respiratory efforts.

The mutuality of muscular hypertonicity, hyperextension of the head, lateral conjugate strabismus, instantaneous cyanosis and abrupt cessation of respiratory efforts associated with both transection of the coronary artery and perforation of the left ventricular myocardium is striking! Only the feature of apparent extreme pain as manifested by constant writhing was lacking in the latter instance.

Acute Cardiac Dilatation. Although extremely rare, acute cardiac dilatation does occur and is a genuine possibility to be considered in a situation such as we have described. It may result postoperatively either because of the manipulation during surgery or because of an unusual strain placed upon a particular chamber as a result of an incorrectable reflux of blood.

Acute cardiac dilatation is characterized by the usual signs of acute congestive failure and the particular symptoms will be colored by the mechanism giving rise to the dilatation, i.e., increased venous return, reduced ventricular output. "Forward" failure is apparent and shock is constant. Sweating tends to be quite profuse. The picture is almost identical to that of the syndrome of mitral insufficiency described in the succeeding paragraph.

Syndrome of Surgically Induced, Dynamically Significant Mitral Insufficiency. This syndrome has been observed by the Hahnemann Group to comprise basically: (1) severe hypotension or actual shock, (2) extremely abnormal degree of diaphoresis (over and above the usual "clamminess" characteristic of peripheral vascular collapse), (3) progressive dyspnea and orthopnea, (4) increased cardiac rate almost regardless of the type of rhythm, (5) increased cardiac size, particularly of the left ventricle, (6) progressive, unalleviable combined ventricular failure and (7) death, usually within forty-eight hours following the conclusion of the surgery.

Acute Pericarditis with Appreciable Pericardial Effusion. Acute aseptic pericarditis following mitral valvular commissurotomy occurs with great regularity[4] for the simple reason the heart and its contiguous structures have undergone greater or lesser degrees of manipulation. Very infrequently this benign form of pericarditis is aggravated by the production of excessive amounts of effusion none of which, to date, has become contaminated. Appreciable pericardial effusion, however, has posed the usual delicate problems of management especially worrisome in the newly operated patient.

One of the most valuable points of diagnostic assistance on this problem has stemmed from the radiologists' suggestion to include a supine postero-anterior chest film as a routine study in the preoperative assessment of candidates for mitral valvular commissurotomy.[5] This, when compared with a postoperative film, has facilitated the radiologic recognition at least of appreciable amounts of pericardial effusion and has been of as much value as any other single item in arriving at the correct inference.

Precordial pain has not been an illuminating symptom. This is true because it is difficult to differentiate pericardial pain from that associated with the extensive operative wound and also, in some cases pericardial pain in the presence of a small or only moderate effusion has been minimal or absent. In one instance, furthermore, despite a febrile rise to 102°F. and a sanguinoserous effusion of more than 450 cc. the heart rate was maximally only 80/min. (atrial fibrillation with digitalization).

From an auscultatory viewpoint it has seemed to us that consistently there has been surprisingly little "damping" of the cardiac sounds.

The conventional criteria, otherwise, obtain for the diagnosis of acute pericarditis. Dyspnea, orthopnea and tachypnea are prominent together with the tendency toward arterial hypotension or even frank shock. However, the usually noted increase in venous pressure is observed rarely in this syndrome.

Acute Myocardial Infarction. Acute myocardial infarction has not occurred at any time in our experience as a result of mitral valvular commissurotomy. Attention is drawn to that diagnostic possibility here particularly because of the apparent extreme pain suffered by the patient noted in this case report. The pain was indisputably disproportionate to that usually attributable to the operative procedure. We do not attempt to explain its occurrence in this case.

The other routine findings of acute myocardial infarction need no elaboration at this time. It is regrettable that an electrocardiogram was not obtained during the climactic period following the patient's return from the operating room.

Pulmonary Embolism. Frequently pulmonary embolism is accompanied by little or no pain. If pain is present, this symptom becomes unreliable as a differential feature between pulmonary embolism-infarction and transection of the coronary artery. Cyanosis, on the other hand, is observed commonly with pulmonary embolism-infarction. Pain was intense in our case of coronary artery transection but there was *no* evidence of cyanosis until the terminal stage. This would seem to be a very pertinent observation. The other classical symptoms and signs of pulmonary embolism may be shared by both lesions.

Ventricular Fibrillation. Experimentally, ventricular fibrillation has been reported to follow ligation of the coronary artery.[3] Since ventricular tachycardia developed in our patient on the operating table, even though subsequently we were unable to auscultate the heart rhythm and failed to obtain an electrocardiogram, it is logical to assume this might have partially accounted for the modus exitus. In any event, it probably was not the decisive factor but definitely merits inclusion in the differential diagnosis.

Complete Heart Block Progressing to Cardiac Standstill. Sudden death is no less frequently attributable to cardiac standstill than to ventricular fibrillation. Exposure of the heart during any type of operative procedure may be highlighted by asystole. In our case this arrhythmia did not seem likely, especially in view of the course during surgery. It is the least likely mechanism adequate to explain death in such a case but warrants inclusion in the list of plausible diagnoses.

SUMMARY

This complication—surgical division or partial division of the circumflex branch of the left coronary artery from *within* the cardiac chamber—is quite possible anatomically if the valvular division is carried not only *to* the myocardial wall but actually *into* the wall. Its location deep within the pad of fat occupying the strioventicular groove renders this risk inherent in the operation of commissurotomy either by the instrumental or the digital pressure technic. In a second case the failure of the relatively inexperienced operator (a competent surgical resident) to keep the guillotine closed during the intracardiac manipulations other than the definitive valvulotomy may have been primarily responsible for this type of accident. Our irrevocable rule is that *the instrument must be closed at all times except when actually applied to the valve.*

The detailed clinical course following surgical transection of the coronary artery is described. Differential diagnosis of acute lesions peculiarly complicating the procedure of mitral valvular commissurotomy is discussed succinctly.

Acknowledgments: We wish to thank Drs. George D. Geckler, Raymond C. Truex, Henry S. Ruth, B. Marvin Hand, Hector P. Rendondo Ramirez and Harry D. Lykens for their helpful suggestions in the study of this case.

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Surgical Review

REVIEW OF 4,284 FRACTURES

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THIS is a preliminary study, carried out for the purpose of observing the distribution of fractures of the various bones as might be seen in a General Hospital. From July, 1943, to July, 1951, 4,284 fractures were treated at the Charleston General Hospital, which is located in the vicinity of a coal mine district.

The various methods used in their treatments are enumerated, with mention of the author's impressions of their respective values. In subsequent papers an attempt will be made to evaluate carefully and accurately the morbidity and mortality of the various methods.

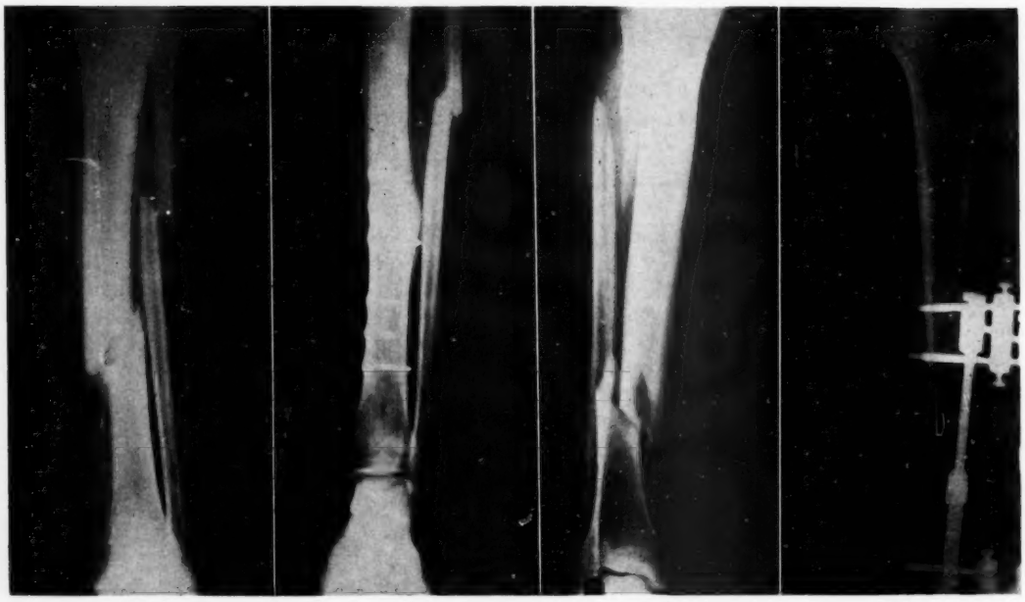
Wrist and Forearm. There were 831 cases of fractures of the wrist or forearm, or 19.4 per cent of the total number of fractures treated. When reduction was necessary, it was carried out under sodium pentothal or local anesthesia followed by application of sugar tong splint or long arm cast.

In treating comminuted fractures located close to the wrist we have found it essential to flex and pronate the wrist to avoid slipping of the fragments. Cast immobilization was continued for five to six weeks. Generally speaking, in children the fractures of forearms were greenstick in nature, requiring reduction and application of cast. In adults, however, the fractures of forearms were frequently oblique or comminuted, necessitating open reduction and internal fixation. In 1944 Kirschner wires were used in both bones. However, we believed that there was a definite tendency for angulation of the radius following the curvature of the Kirschner wire. We also believed that there was too much discrepancy between the diameter of the medullary cavity of the bones and the size of the Kirschner wire. We now think it much more desirable to plate the radius and use heavy intramedullary fixation of the ulna. (Fig. 1.) The pin is permitted to protrude through the skin at the elbow and is easily extracted after union has occurred.

FIG. 1. The ulna is fixed with intramedullary Steinmann pin and the radius is plated.

In several cases immediate single onlay bone grafts of both bones were performed because of the comminution or obliquity of the fractures. These grafts were removed from the fibula. We believe this relatively extensive procedure can be justified by the fact that it seems to reduce the morbidity and uncertainty of union in many of these cases. We believe the fibula has sufficient strength and is more osteoplastic than the tibial bone, and has more strength than the os ilii.

There were nine cases from this series in which late bone graft was required for nonunions. Gas infection developed in one case from an insignificant skin abrasion in spite of the usual cleansing. In this case there was



2A 2B 3A 3B

FIG. 2. A, fractured tibia and fibula on admission; B, same case with consolidation of fragments six months after open reduction and plating.

FIG. 3. A, fractured tibia and fibula on admission; B, same case following closed reduction and fixation with Haynes' apparatus.

complete loss of the flexor tendons, necessitating amputation through the mid-forearm.

Among other complications was the inability to supinate due to radial-ulnar separation, necessitating late resection of the distal end of the ulna. Although the condition was not very disabling, there were several cases showing late atrophy of the hypothenar eminence. This was believed to be due to inclusion of a portion of the deep branch of the ulnar nerve in the callus or scar tissue.

Tibia and Fibula. There were 633 cases of fractures of the tibia and fibula or 15 per cent of the total number of fractures treated. In children greenstick fractures predominated, usually necessitating reduction and application of cast under general anesthesia.

In simple fractures in adults our usual practice has been to insert one Steinmann pin above and one below the fracture, and to apply a cast after reduction on an Anderson frame.

The compound fractures are all treated as emergencies. The fracture site is exposed and bone ends cleansed with copious amounts of water; the skin edges are débrided. Bony fixation is obtained by the use of a plate or screws and a plaster cast is applied. (Fig. 2.)

In fractures of the tibia and fibula which are complicated by visceral damage we do not hesitate to incorporate the extremity or extremities in ice to await improvement in the patient's general condition which would permit definitive treatment. When no tourniquet was necessary, we have been able to salvage the extremity even after one week of ice application.

Special mention should be made in regard to the value of external skeletal fixation in treating fractures of the tibia in this geographic area. (Fig. 3.) The coal miner in West Virginia frequently works in a seam of coal not more than 4 feet in height. Indeed, he must frequently dig and load coal sitting on his heels. Thus any impairment of motion of the knees is tantamount to total disability. When Haynes' external fixation is applied, the patient is able to lie in bed and exercise his knees within thirty-six hours. We have not experienced non-union or osteomyelitis in forty-three cases so treated. On several occasions we have discontinued the use of Haynes' apparatus after several weeks because the patients insisted on pouring whiskey or other liquids on the pins.

Circulatory complications have been most interesting and difficult problems. In one case of crushing injury the circulation in the foot appeared inadequate. The posterior tibial

artery was exposed and it was possible to see the exact location of cessation of pulsation. As soon as this point was exposed, the pulsation passed on down through the extent of the wound. The tibia was plated and the soft tissue closed; the foot remained viable.

In another similar case, when the point of cessation of the pulsation was exposed, the spasm of the artery ascended. Any attempt at stripping merely caused the spasm to ascend. Periarterial novocain had no beneficial effect. The bone was quickly fixed by plating, and sympathetic injections were repeatedly carried out with no beneficial effect. This extremity was removed when dry gangrene ensued.

We now believe that upon original examination and treatment it is impossible to predict which crushed extremity must be removed and which can be saved. On several occasions the extremity was left against the author's best judgment and remained viable; in other cases in which we believed that extremities were viable, and even when they became warm after bony fixation and sympathetic blocks, amputations were necessary because of subsequent gangrene. Up to this time we do not believe that we have jeopardized the life of any patient because of delay in amputation.

Fingers and Toes. Multiple finger or toe injuries were considered as one case. There were 476 cases, or 11.3 per cent of the total number of fractures treated. There is a general tendency to consider these injuries relatively minor but there is no denying that their frequency and their marked tendency to develop stiffness make their economic significance very great. One must obtain excellent early reduction and the reduction must be maintained for the shortest possible period. We believe that elastic traction for about three to four weeks is a must in the majority of cases of shaft fractures.

Cleansing must be faultless since infection will in many cases lead to permanent disability.

Spines and Transverse Processes. There were 317 cases of fractures of spines and transverse processes or 7.4 per cent of the total of all fractures treated. These extend from relatively insignificant linear fractures of transverse processes to severe fracture dislocations with paraplegia.

Those patients with fractures of transverse processes were formerly treated as ambulatory patients; however, since the development of a

4A 4B

FIG. 4. A, fracture dislocation between the third and fourth lumbar vertebrae; B, same case following operative reduction and fixation of spinous processes with wire.

case of Kümmell's disease with loss of 8 inches in height, we now admit these patients to the hospital for a period of four to seven days until the pain subsides. They are then fitted with Taylor back braces or corsets and encouraged to carry out activity within the limits of pain.

The compression fractures are first treated by hospitalization for pain and frequent paralytic ilius. We prefer the Goldthwaite method of hyperextension and application of cast. Activity is encouraged as much as the patient will tolerate it. We believe that muscle development is the most important factor in the treatment of fractures of the spine.

The problem of immediate treatment of patients with fracture deformities of the spine with cord or cauda equina injuries is one of the most difficult ones facing us. To say that all fracture-dislocations of the spine should be subjected to immediate laminectomy and reduction does not seem tenable, as certainly there is nothing to be gained by exposing completely lacerated cord or cauda equina. On the other hand, we must admit that in most cases surgery does no harm.

In trying to avoid useless surgery we have depended upon changing signs as the cardinal indication for surgery. We quote briefly a few of our experiences with laminectomies:

One patient in whom paralysis developed

5A 5B

FIG. 5. A, fractured humerus with angulation of the fragments; B, same case with satisfactory result after treatment by hanging cast.

on the second day after admission had an emergency laminectomy with nearly complete return of function. (Fig. 4.) Another patient complained of severe tingling in the toes but was found to have complete transection of the cauda equina; the lacerated ends appeared as the ends of a tassel. Another patient was paralyzed immediately following injury, with gradual return followed by gradual loss of motor function. This patient was first seen by us five days after the onset of second paralysis and nineteen days after the original injury. Immediately laminectomy was performed and a scar tissue ring measuring ½ cm. in thickness was removed. Queckenstedt became negative but the patient did not regain motor function during the three months he was observed. Another patient with a mild compression fracture with paralysis at the ilioinguinal nerve level showed evidence of ascending paralysis. She was advised to have a laminectomy but the family refused. On death autopsy showed severe hematomyelia with actual degeneration of the cord extending into the medulla oblongata.

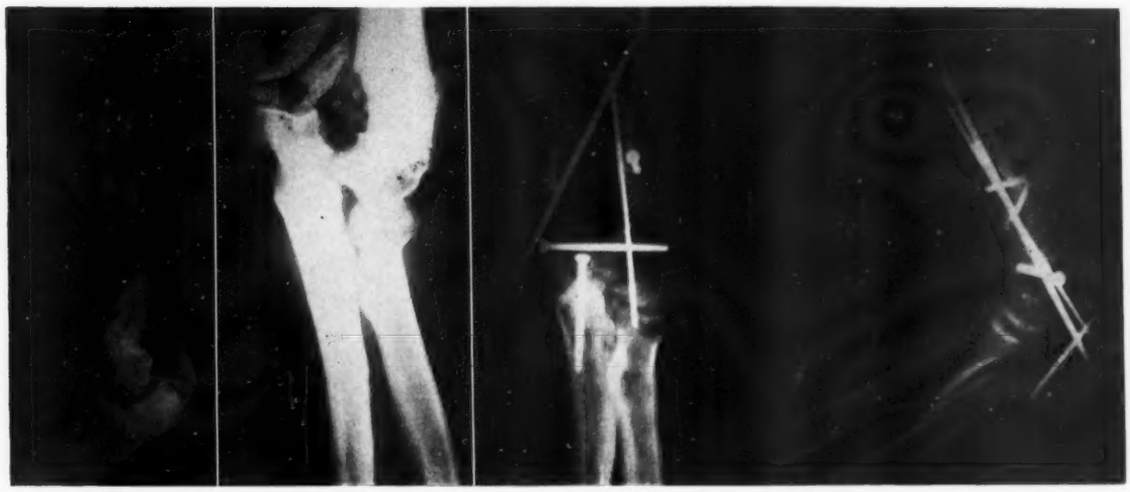
Humerus, Including Supracondylar Fractures. There were 311 cases of fractures of the humerus or 7.2 per cent of the total number of fractures treated. After experiences with various types of abduction casts we now believe that the majority of these shaft fractures can best be treated by hanging casts. At times it is difficult to satisfy the family when it is apparent that reduction is not all that one may wish, but the excellent functional result justifies its continued use. (Fig. 5.)

It should be remembered that alignment of the fragments can be materially changed by (1) shortening or lengthening the sling, (2) placing the point of sling fixation distally or proximally, (3) placing the traction point toward extensor or flexor surface and (4) the weight of the cast.

Supracondylar fractures with displacement are reduced immediately and traction is applied with the arm extended beyond the edge of the bed. The traction is applied in two directions thus obtaining Dunlap traction effect. The elbow is held at about 90 to 100 degrees. We have not yet had a case of Volkmann's ischemic contracture.

T-type fractures with separation are treated by fixing the two lateral fragments with screws and inserting a Steinmann pin through each epicondyle into the proximal shaft of the humerus. (Fig. 6.) The ulnar nerve is transplanted.

Ribs and Sternum. There were 265 cases of fractured ribs or sternum, or 6.1 per cent of the total number of fractures treated. The majority of these were treated with simple immobilization by a rib band or adhesive strapping. The more severe fractures with lung or pleural injuries appear to follow a fairly definite pattern. In lung or pleural injuries where the respiration is higher than 35 per minute the pleural cavity should be aspirated. If pneumothorax is found, we rely



6A 6B 6C

FIG. 6. A and B, compound, comminuted fracture of elbow on admission; C, same case after open reduction and fixation with screws and Steinmann pins.

upon continuous aspiration with a tube placed under the water surface. It is believed that treatment should be continuous as hemothorax can be expected after twelve to twenty-four hours. The needle must be changed frequently, for bleeding from the expanded lung will quickly close the needle. We have removed up to 900 cc. of blood without ill effect. In cases with paradoxic respiration we have attempted rib cage traction with large towel clamps. These cases were complicated by other fractures and resulted in death. At times we have found that there were many more rib fractures at autopsy than were seen by x-ray. Some fractures of the sternum with step-down displacement were surgically reduced while others were untouched with no residual complaints. (Fig. 7.)

Tarsals and Metatarsals. There were 241 cases of fractures of tarsals or metatarsals, or 5.6 per cent of the total number of fractures treated. As a general rule we have remained conservative in the treatment of these cases. In treating a severely displaced metatarsal we now resort to open reduction and insertion of an intramedullary Steinmann pin. The pin is allowed to protrude through the skin on the plantar surface.

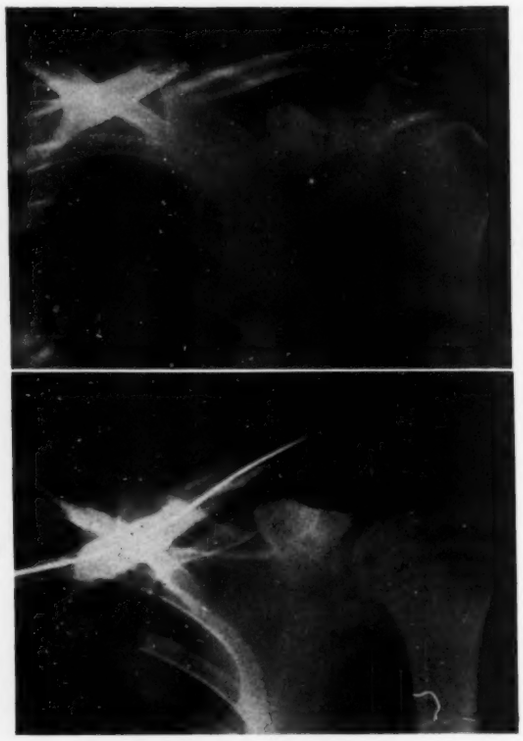
Comminuted crushing fractures of tarsal bones frequently result in painful feet. These are later treated by arthrodesis.

Clavicles. There were 224 cases of fractures of clavicles or 5.2 per cent of the total number of fractures treated. The majority of these occur in children and they are treated by application of a figure 8 bandage or a T splint.

FIG. 7. Fracture of sternum with step-down deformity; satisfactory result without surgery.

In adult fractures with severe comminution or wide separation of the fragments we now resort to intramedullary fixation with a heavy Kirschner wire. (Fig. 8.) Several other external fixations have also been used with success.

In young females in whom a bony promi-



8A

8B

FIG. 8. A, fractured clavicle with displacement of the fragments; B, same case following open reduction and fixation of the fragments with Kirschner wire. The fracture of the glenoid was treated conservatively with good functional result.

nence or a scar is highly undesirable we believe the treatment should be recumbency for two weeks. Even when satisfactory reduction is not maintained, the fractures will unite and will show very slight palpable deformities.

Carpals and Metacarpals. There were 212 cases of fractures of the carpals or metacarpals, or 4.9 per cent of the total number of fractures treated. We believe that carpal fractures will unite without difficulty if (1) they are treated early, (2) there is not too much displacement and (3) fixation is continued for a long enough period.

Metacarpal fractures with little displacement are treated by application of a metacarpal grip with dorsal pressure. Patients with displacement of more than one-third of the width of the metacarpal are treated by open reduction and insertion of an intramedullary Steinmann pin. (Fig. 9.) The pin is allowed to protrude through the skin at the knuckle. In some cases with palmar angulation we resort to Boehler type cast.

Pelvis. There were 179 cases of fractures of the pelvis or 4.1 per cent of the total number of fractures treated. These were formerly treated by application of casts; however, the resulting stiffness was so disabling that we now employ pelvic slings for a period of five to six weeks. On admission to the emergency room patients are catheterized to rule out genitourinary injury. If no blood is found in the urine and there is no evidence of bowel damage, patients are started on prostigmine and placed in pelvic slings. In cases of injuries to the genitourinary tract immediate pyelographies and cystographies are performed. The injuries are then treated as emergencies by the genitourinary department.

In order to improve the position of the fragments of the pelvis we occasionally find it necessary to use balanced traction on one leg or even Anderson well-leg traction in addition to the pelvic sling. (Fig. 10.)

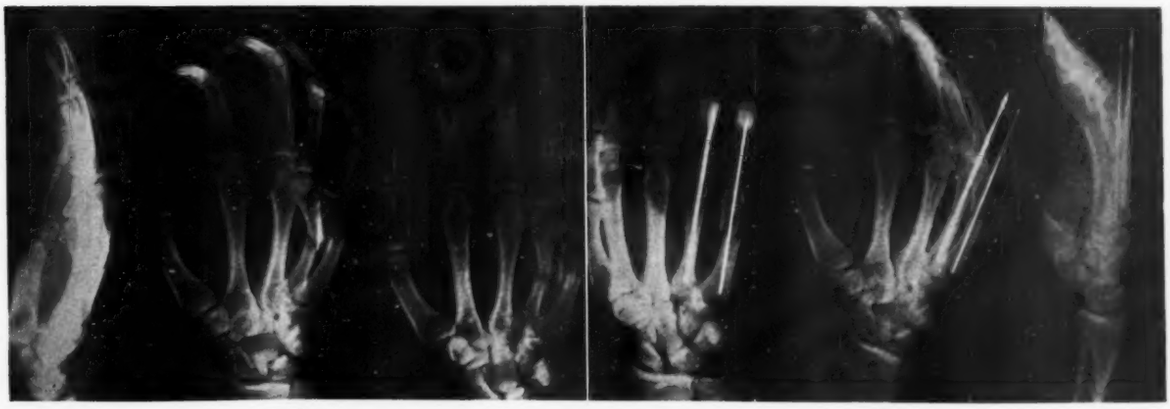
As early as possible patients are encouraged to begin motion in their hips in order to avoid stiffness. In severe comminuted fractures we have noted several cases of peroneal nerve paralysis which later required stabilization of the ankle. No case of paralysis of the tibial nerve group of muscles has been observed. In comminuted fractures thrombophlebitis has frequently been seen. These have been self-limiting.

Femurs. There were 177 cases of fractures of femurs or 4.1 per cent of the total number of fractures treated. Femoral shaft fractures in children are treated with Bryant overhead traction followed by application of a hip spica cast. (Fig. 11.)

Most simple fractures in adults are first placed in balanced or Russell traction. (Fig. 12.) Those that cannot be reduced satisfactorily by conservative means are opened and plated. Compound fractures are immediately opened wide, adequately cleansed and plated.

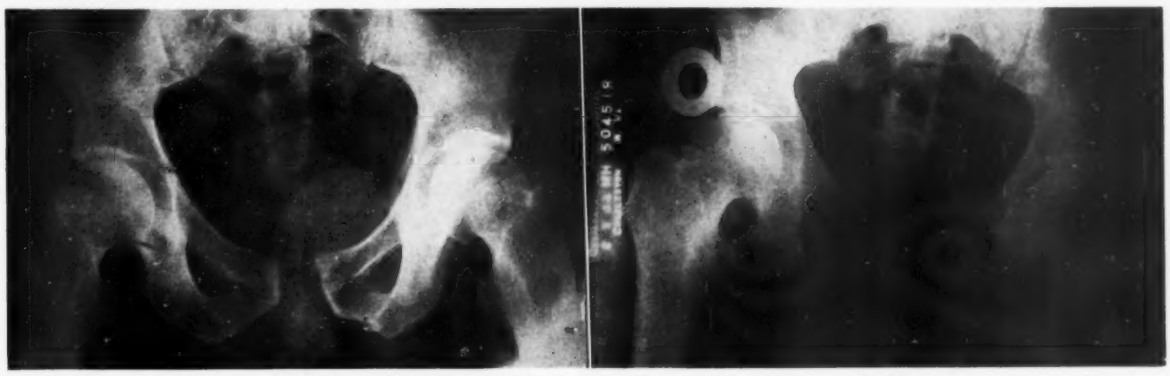
We have had to perform arterial repair in several cases using the Blakemore tubes. In one case the pulsation could be felt coming through below the site of repair following surgery, but the extremity later became gangrenous necessitating amputation. Study of the removed artery showed complete occlusion in spite of the use of anticoagulants.

The use of external fixation of the fragments is encouraged only when it may be necessary to move the patients. (Fig. 13.) In pathologic fractures due to metastatic lesions we have found it a convenient method that allows



9A 9B

FIG. 9. A, fractures of fourth and fifth metacarpals on admission; B, same case following open reduction and insertion of intramedullary Steinmann pins.



10A 10B

FIG. 10. A, fractures of the pubis and ischium on left side, with separation of the symphysis pubis; B, same case showing closure of the separation of the symphysis under sling treatment.

application of roentgen ray therapy and permits the patient to be reasonably comfortable at home.

Our experiences with intramedullary fixations have not been without complications. We have experienced bending and breaking of nails. However, with the newer nails these dangers appear to have been overcome. (Fig. 14.) As other workers have experienced, we find knee stiffness a major disability in the fractures of femurs.

Hips. There were 127 cases of fractured hips or 2.9 per cent of the total number of fractures treated. In intracapsular fractures we have followed the usual fixation methods, using Smith-Petersen nail, Godoy-Moriera screw or Collison screw.

In peri- or subtrochanteric fractures when the patient's general condition permits we generally use the Moore plate (Fig. 15), Lorenzo screw or Smith-Petersen nail into the neck and head of the femur with a side plate. (Fig. 16.) When the patient appears to be a poor surgical risk, we resort to Anderson's well-leg traction method, with careful medical support to avoid complications. (Fig. 17.)

Several cases of neck fractures were treated by insertion of a tibial graft instead of metal pins. (Fig. 18.) We believe that these cases definitely show earlier union. However, in the aged if a plaster cast must be used, it may defeat the very aim of the treatment. The use of bank bone may materially reduce the operative time.

Ankles. There were 101 cases of fractures of ankles or 2.3 per cent of the total number of fractures treated. We believe that careful manipulation and application of a cast with the foot in inversion will allow excellent anatomic and functional results. (Fig. 19.)

Even in cases of severe fracture-dislocations we find the results of conservative treatment to be superior to open reduction and metal fixation. (Fig. 20.) Even in some cases of

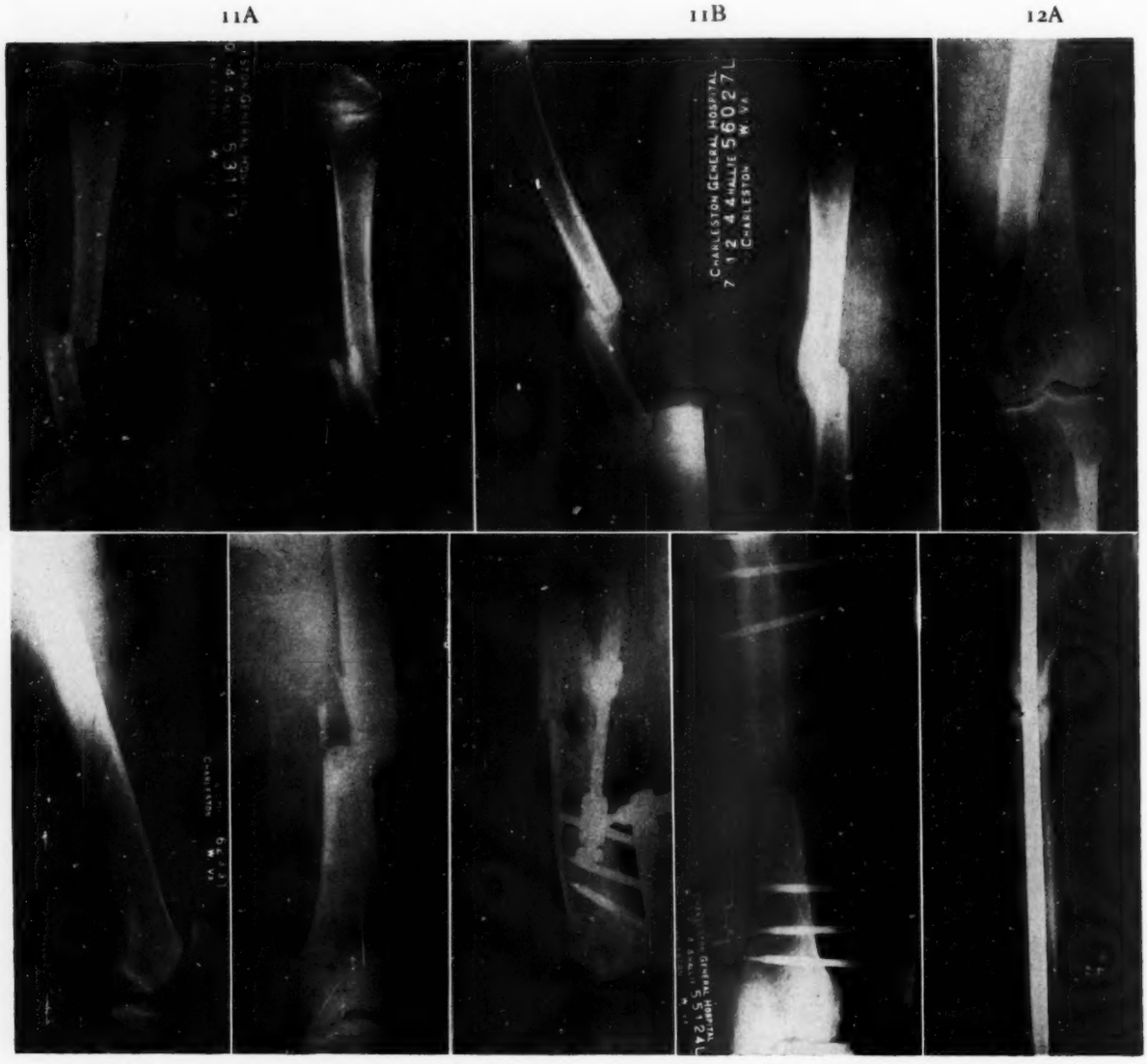


FIG. 11. A, fractured femur with slight over-riding of the fragments; B, same case following treatment with Bryant's traction. Excellent functional and cosmetic result in spite of the displacement.

FIG. 12. A, spiral fracture of the femur; B, same case showing anatomic reduction with Russell traction.

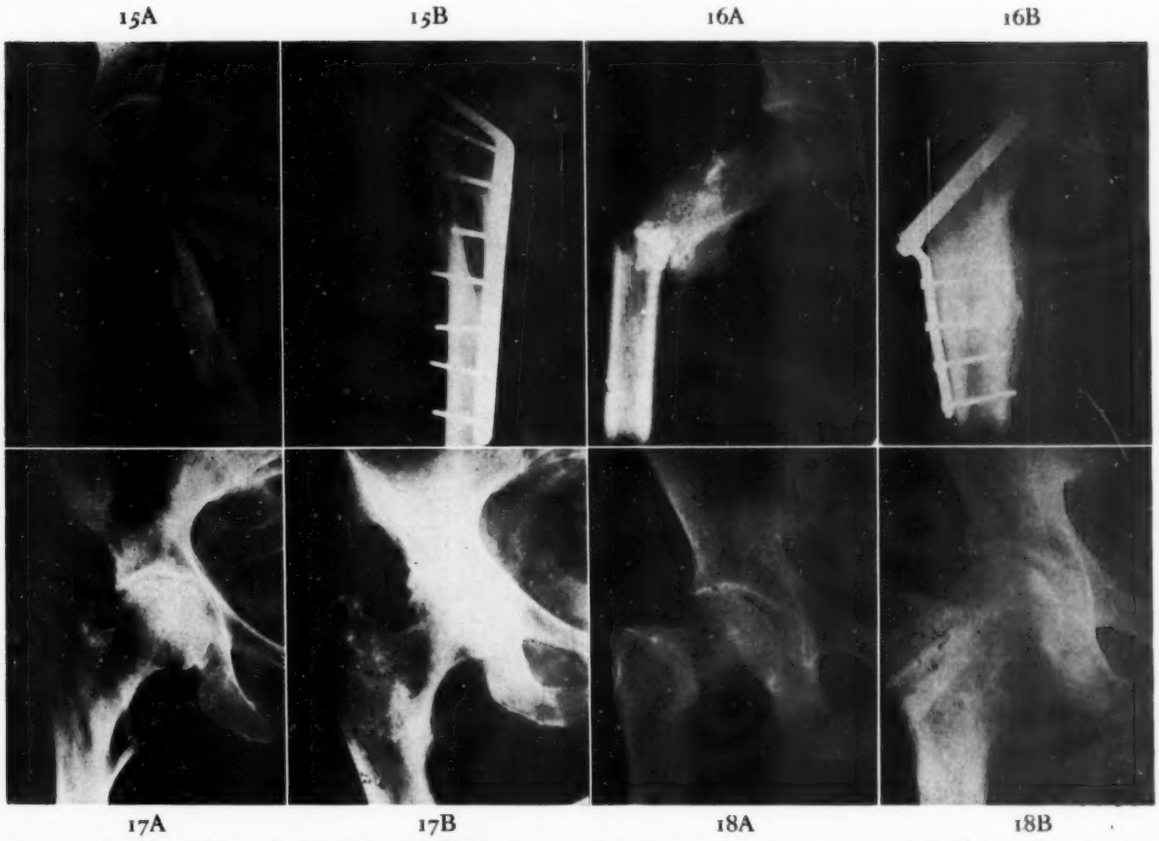
FIG. 13. A, comminuted fracture of the femur; B and C, same case following open reduction and fixation of the fragments with Haynes' apparatus. (Early patellectomy has been performed due to severe comminution.) Subsequent result was excellent.

FIG. 14. Excellent union and functional result with intramedullary fixation of the femur.

compound fracture–dislocations we have found this to be true. Our practice in simple fracture-dislocations is to try closed reduction; open reduction is performed only after repeated failures. If surgery is necessary, simple insertion of a screw or screws seems to suffice. The screw is placed so as to re-establish satisfactory mortice.

Mandibles. There were fifty-six cases of mandibular fractures or 1.2 per cent of the total number of fractures treated. These cases are generally treated by maxillomandibular wiring. In other cases we have used external fixation with success. (Fig. 21.)

It should be stated that there are occasional cases with temporomandibular dislocation in connection with the mandible fracture. The dislocation must first be reduced before the fracture can be reduced. Since the majority of these cases are compound fractures into the



15A 15B 16A 16B

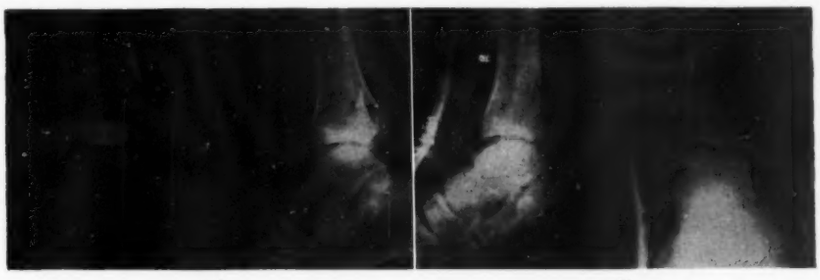
17A 17B 18A 18B

FIG. 15. A, subtrochanteric fracture with displacement of the fragments; B, same case following open reduction and fixation with Moore plate. Excellent functional result following removal of plate and screws.

FIG. 16. A, subtrochanteric fracture with angulation; B, same case following open reduction, insertion of Smith-Petersen nail and application of side-plate. Bone cyst at fracture site was curetted and subsequently healed.

FIG. 17. A, transtrochanteric fracture of the hip; B, same case with excellent union following well-leg traction. Good functional results.

FIG. 18. A, low neck fracture of the hip; B, same case showing excellent union following insertion of two bone grafts.



19A 19B

FIG. 19. A, trimalleolar fracture of the ankle with separation of the mortice; B, same case following closed reduction and application of cast.

mouth, adequate antibiotic treatment must be given.

Os Calcis. There were forty-eight fractures of os calcis or 1.1 per cent of the total number of fractures treated. These cases are generally treated by insertion of a Steinmann pin through the distal tibia and another through the os calcis. The lateral spreading is decreased with Thomas wrench and Boehler angle is re-established. Plaster cast is then applied. The frequent need for arthrodesis due to pain cannot be denied.

20A 20B

FIG. 20. A, dislocation of the ankle; B, same case following closed reduction.

21A 21B

FIG. 21. A, fractures of both sides of the mandible; B, same case following reduction and fixation of the fragments with an Anderson apparatus.

FIG. 22. Fractured scapula treated conservatively with excellent functional result.

In several cases with severe disturbance of the subtalar joint immediate arthrodesis was performed with gratifying decrease in morbidity.

Patella. There were forty-seven cases of fractures of patellas or 1.1 per cent of the total number of fractures treated. In patients with large fracture fragments, open reductions and fixations by wire, cutis or other suture material were carried out. Where there are multiple fragments, we believe that the treatment of choice is resection of all fragments. The quadriceps and patella tendons are attached by a tongue of quadriceps tendon, turned down so as to leave the same amount of space between the tendons as when the patella was present. We have not experienced any weakness in the knee due to resection of the patella.

Scapula. There were forty-one cases of fracture of the scapula or 0.9 per cent of the total number of fractures treated. We have had occasion to see cases of rather badly displaced fragments in which we anticipated the need for later removal. To our surprise the patients have all returned to work and such

fractures have not been the cause of undue morbidity even in compensable cases. (Fig. 22.)

CONCLUSIONS

The author recognizes the fact that this has been a brief summary. However, it is believed that a short over-all picture of a service at a general hospital may be of some value.

Cases of single fractures appear relatively simple in their management but it is the case with multiple fractures or other complicating injuries which tries the acumen of the operating surgeon.

Fractures of the pelvis with genitourinary injuries require the closest cooperation between the orthopedic and the urologic surgeon. In patients with urinary tract injury or visceral damage treatment of that condition must take precedence over the treatment of the extremities if we are to decrease our mortality. Others with lung damage must forego extremity treatment until the respiratory damages have been brought under control.

Patients with intracranial damage must certainly receive treatment of that condition before extremities can be rendered definitive treatment.

Even when the problem is limited to extremities, one must consider the urgency of the treatment of each fracture in relation to the patient's general condition. For this reason we must have at hand all of the different methods of treatment in order to render the patient the best possible service. In this regard the use of ice and external fixations has been of great value.

Acknowledgment: The author acknowledges the invaluable aid rendered by Drs. Lee Hanenson, Glen Palmer, Jack Sugar, Carl Horn, Raymond Dasso, Douglas McInnis, Irvin Warth and George Callender who were resident surgeons during this period.

Streamlined Articles

CONGENITAL ABSENCE OF GALLBLADDER*

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THIS study includes the report of a case of agenesia of the gallbladder and an appraisal from the literature of features of this disorder which seem significant and noteworthy. Cholangiogram in this case demonstrated absence of the gallbladder and no intrahepatic gallbladder. Although agenesia of the gallbladder may be symptomless, more than half of a series of sixty patients (according to Dixon and Lichtman) gave symptoms of cholecystic disease. The case herein reported gave symptoms which might be attributed to chronic gallbladder disease.

Persistent absence of the gallbladder shadow in cholangiograms may mean agenesia in a small number of cases.

* * * *

Tallmadge[1] (quoted by Drenckhahn and Rogers[2]) found the incidence of this anomaly to be 12 in 18,530 cases or 0.65 per cent. Among recent reviews of the literature on this subject are those by Dixon and Lichtman,[3] and by Latimer, Mendez and Hage.[4] Dixon and Lichtman[3] have directed attention to two theories that have been advanced to explain the congenital absence of the gallbladder: (1) due to failure of the gallbladder to develop from the hepatic diverticulum and (2) failure of the gallbladder bud to resolve from its solid embryologic stage. The presence of a solid cord residue would favor this latter theory. Boyden[5] in 2,700 cats found the gallbladder absent in three kittens (two females, one male). In the hope of finding an explanation of the anomaly Boyden examined 200 cat embryos of appropriate age in the Huntington collection of Columbia University. One of these embryos revealed the gallbladder in the act of disappearing. In this embryo withdrawal of the gallbladder from its position on the ventral body wall just medial to the place where the right umbilical vein entered the liver had been prevented from developing by a circulet of veins which enclosed the neck of the organ, as a result, it seemed to be thinned out and ruptured.

From comparative anatomic studies[7] one learns that in certain animals, for example the petromyzon, pigeons and rats, the gallbladder diverticulum is present but disappears as the embryo matures. In closely related species of animals the gallbladder may be present or absent.

Gallbladder	No Gallbladder
cow	horse
sheep	deer
hog	peccary
wild boar	rat
moose	

Mentzer[7,8] in an exhaustive study stated that the gallbladder was uniformly absent in twenty-six species of mammals including the goat, deer, rat, rhinocerous, peccary, pilot whale, hyrax, two and three-toed sloth, ass, horse, mule, seventeen species of fish including petromyzon and nine species of birds including dove and pigeon.

SYMPTOMS

The absence of a gallbladder in man may be symptomless but more commonly this anomaly is accompanied with symptoms of biliary tract disease.[6] In the Dixon and Lichtman[3] series of sixty cases approximately 58 per cent gave symptoms of cholecystic disease, about 48 per cent of the cases had jaundice and 26.6 per cent had choledocholithiasis. In the group of patients past forty-five years of age in this series 73 per cent gave symptoms of cholecystic disease. In 25 per cent of this series of cases cholecystography failed to produce visualiza-

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tion of the gallbladder. Stones were seen in the region of the common bile duct in four cases.

OPERATION

In the series of cases reported by Latimer, Mendez and Hage[4] of the thirty-six operated upon, the preoperative diagnosis was cholecystitis in fifteen and in eight it was obstruction of the common bile duct; only five cases were listed as exploratory laparotomies and in four patients an operation was performed for non-associated intra-abdominal disorder; in another four cases no preoperative diagnosis was made.

These and other observers[2–4,6] have emphasized the frequency of common duct disorders in agenesia of the gallbladder and have advised prolonged drainage of the common bile duct by means of a T-tube in congenital absence of the gallbladder in which symptoms were present, even when the common bile duct was of normal size and no stones were present. Another procedure necessary to establish congenital agenesia of gallbladder and rule out an intrahepatic organ was cholangiograms at the time of or after laparotomy.

CASE REPORT

Mrs. B. W., a housewife, aged forty-five years, entered the Clinic on November 2, 1948, complaining of headaches, painful joints, rapid pulse, shortness of breath and gallbladder trouble.

For several years she had suffered from recurring severe headaches at times associated with nausea and vomiting. For three to four years she had pains in hips, arms, legs and left shoulder. The patient dated all these pains in her joints from a fall suffered eighteen years before. These joint pains came and went and were worse in cold, damp, rainy weather. In June, 1947, the patient had an attack of severe epigastric pain associated with tachycardia. A local physician was called and a tentative diagnosis of angina was made. Since that time the patient has had several more of these attacks and during one of the more recent attacks she was seen by another physician whose diagnosis was gallbladder trouble.

Roentgen studies were made of the gallbladder and poorly functioning gallbladder was diagnosed. A special diet was prescribed; while on this diet the patient lost considerable weight (30 pounds). About two weeks before coming to the Clinic another attack of tachycardia was experienced.

Physical examination revealed these data: height 61 inches, weight 94 pounds, blood pressure 126/70, pulse 84, temperature 98.0°F. The sclera were clear. The patient was edentulous and wore dentures. There was no enlargement of the thyroid gland. The heart rate was irregular. There was a systolic murmur heard loudest over the base of the heart.

Abdominal examination revealed tenderness along the right costal margin especially near the ninth rib. The spleen was not palpable. There was no other area of localized tenderness in the abdomen. Pelvic examination was unimportant. There was no edema of the legs. Reaction to reflexes were normal.

Laboratory examinations were as follows: Urine, specific gravity 1012, reaction Ph 6, no sugar, no albumin. Microscopically there were occasional pus cells and epithelial cells. Blood examination revealed hemoglobin 82 per cent, 12.2 gm., erythrocytes 4.2 million, sedimentation rate 28, hematocrit 45, leukocytes 8,050, neutrophiles 56 per cent, eosinophiles 3 per cent, lymphocytes 41 per cent, Mazzini test negative, blood urea nitrogen 13 mg. per cent, blood uric acid 4.3 mg. per cent, blood sugar 91 mg. per cent and icterus index 5.

Electrocardiogram revealed rate 100; rhythm S-T with frequent right ventricular premature contractions. P-R interval .16 seconds, QRS interval .06 seconds. Impressions: sinus tachycardia with frequent right ventricular premature contraction. On January 3, 1949, another electrocardiogram tracing revealed no significant change.

Gallbladder roentgenograms were made using double-dose dye technic and no concentration of dye by the gallbladder could be seen. No calculi were seen. A series of gastrointestinal x-ray studies were made and no pathologic disorder could be found in the upper gastrointestinal tract. A barium enema fluoroscopically examined and followed by films revealed no evidence of organic disorder. Roentgenogram of the chest revealed low diaphragm but no other significant pulmonary, pleural or cardiac pathologic condition. Roentgenograms of the cervical, dorsal and lumbar spine and pelvis revealed hypertrophic arthritis with aseptic necrosis of the left femoral head. All roentgenographic studies were made by Dr. Wallace Tirman.

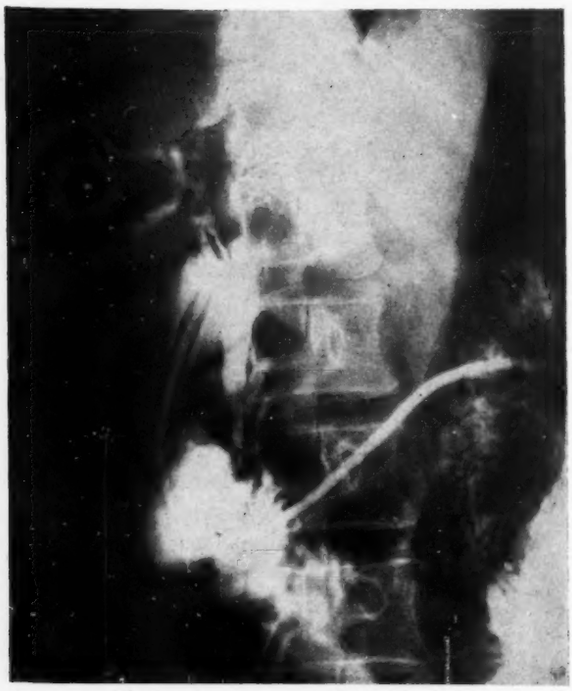

FIG. 1. Cholangiogram revealing the hepatic and common bile ducts and no evidence of a gallbladder.

The patient was sent home and on her return to the Clinic about a month later another series of films were taken attempting to visualize the gallbladder, again using double-dose technic and again no gallbladder shadow could be visualized.

The patient continued to do poorly under medical management and with persistent absence of a gallbladder shadow a preoperative diagnosis of non-functioning gallbladder was made and surgical intervention offered; this the patient accepted.

Operation was performed on January 4, 1949. The preoperative diagnosis was nonfunctioning gallbladder, postoperative diagnosis, congenital absence of gallbladder, cirrhosis of liver, umbilical hernia. Procedure consisted of a biopsy of the liver, exploration for a gallbladder, choledochostomy and appendectomy. A right paramedial incision was made extending from the xyphoid to about a handbreadths below the navel. The operation was done as rapidly as possible because the patient was a poor risk. The rectus muscle was pulled laterally and the bleeding points ligated. The peritoneum was incised and the most striking feature was the liver margin two to three fingers below the costal margin. The transverse colon was plastered to the under surface of the liver by fibrous adhesions. The patient had asked that her appendix be removed and this was quickly done by crushing, ligation and carbolizing the stump. No Meckel's diverticulum was found and no gross change of the pelvic organs was discovered. There was an umbilical hernia not more than 0.2 to 0.3 cm. in diameter. Because of urgency and the small size of the lesion nothing was done about this hernia.

Attention was then turned to the upper abdomen. There was no gross change of the stomach or first part of the duodenum. A finger was inserted through the foramen of Winslow and the common duct could be palpated. The round ligament of the liver was caught with a Pean clamp, the air lock under the diaphragm was broked and the liver lifted upward. The adhesions between the transverse colon and the under surface of the liver were carefully separated. Then and only then did it become apparent that there was no gallbladder present. There was no cleft or fossa in the under surface of the liver and no evidence that there had ever been a gallbladder here.

The peritoneal enfoldment of the common bile duct was carefully incised and dissected away from the organ. The choledochus was enlarged (approximately 0.8 cm. in diameter). The common duct was exposed from near the porta hepatis toward the duodenum for 2 to 3 cm. The hepatic ducts were visualized. There was no nubbin of tissue or evidence of any cystic duct or gallbladder. The choledochus was aspirated with a Luer's syringe using a No. 18 needle and clear bile was obtained.

The common duct was opened and explored with a common duct scoop and flexible probe; both of these passed freely into the duodenum and upward into each hepatic duct. A T-tube was sutured in place in the choledochus. It had been planned to do a cholangiogram on the operating table but because this patient had cardiac damage and because the procedure had taken considerable time this was deferred to a later date. A piece of liver tissue from the right lobe lower edge was removed for microscopic study. The wound was closed with No. 2 plain catgut in the peritoneum and No. 2 chromic in the fascia. The T-tube was brought out about the middle of the wound and the skin was closed with silk.

Cholangiogram on January 10, 1949, by Dr. Wallace Tirman was recorded as follows: "The

dye (diodrast 70 per cent) was injected under gravity into the T-tube. This material was seen to enter the common duct and hepatic ducts without delay. There was also immediate passage into the duodenum. There was no evidence of a gallbladder and no evidence of a diverticulum in the region of the cystic duct. The T-tube entered the right hepatic duct and consequently there was no filling of the left lobe of the liver. On later films there were several small bubbles of air present in common duct." (Fig. 1.)

Two years after the operation the patient was still complaining of arthritis and constipation.

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Gusberg reports finding ten cases of intraepithelial carcinoma and ten cases of basal cell hyperplasia in the coning biopsies done on 500 allegedly normal women. The instrument used produces a superficial conization of the cervix and yet presents the operator with material suitable for biopsy purposes. The method supplements vaginal cytology and should be used more extensively. (*Richard A. Leonardo, M.D.*)

THE BOLEN TEST FOR CANCER*

BEVERLY H. WHITE, M.D., ROBERT R. RECTOR, M.D., JOSEPH M. MILLER, M.D., AND WILLIAM A. OKTAVEC, JR.

Fort Howard, Maryland

A SIMPLE screening test to find patients with cancer would be a valuable diagnostic aid. Bolen[1] has proposed such an examination as a routine office procedure. In this article the authors show that the Bolen test was accurate in only 68.4 per cent of 303 patients studied for cancer. This test therefore is not sufficiently accurate for use as a screening examination for cancer by the average physician.

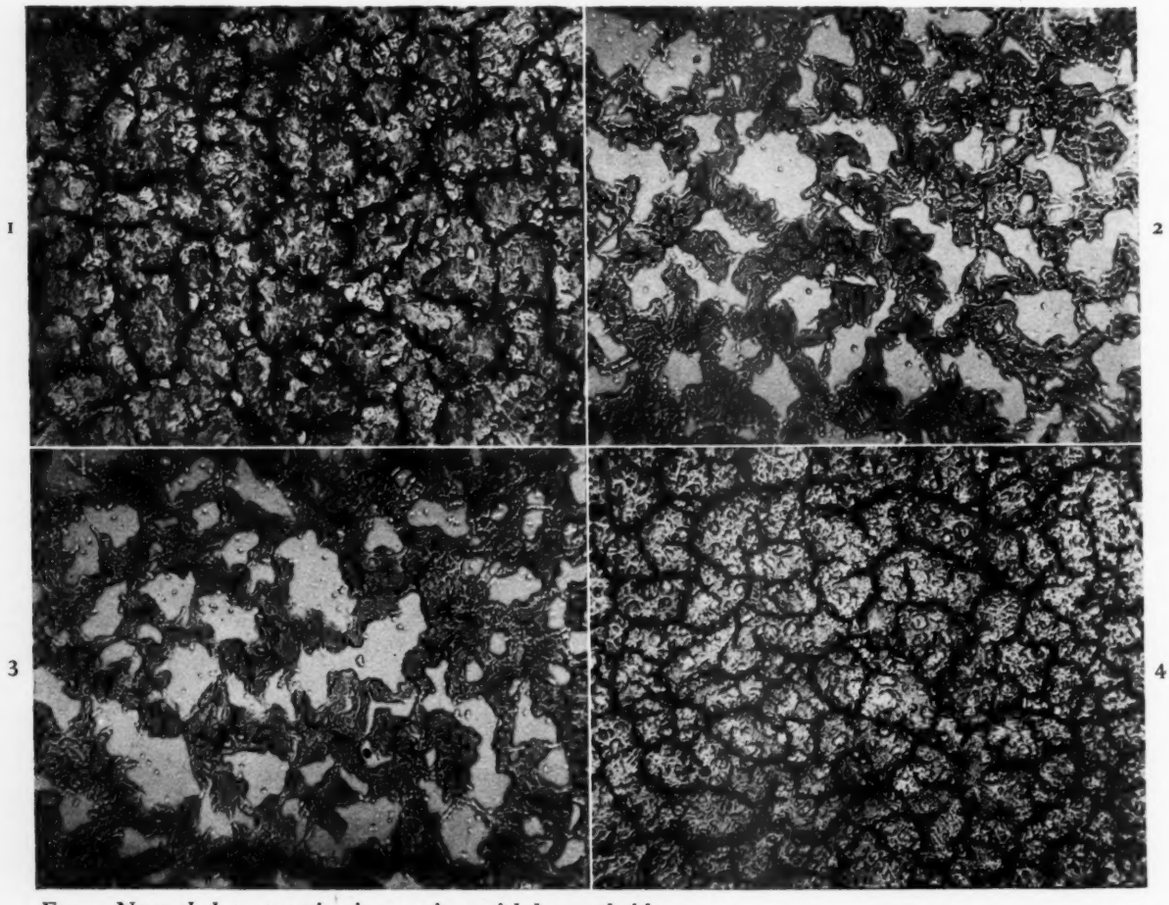

FIG. 1. Normal clot retraction in a patient with hemorrhoids.

FIG. 2. Positive clot retraction in a patient with chronic rheumatoid arthritis. This pattern is indistinguishable from that of Figure 3.

FIG. 3. Positive clot retraction in a patient with bronchogenic carcinoma.

FIG. 4. Normal clot retraction in a patient with carcinoma of the stomach. This pattern is indistinguishable from that of Figure 1.

* From the Veterans Administration Hospital, Fort Howard, Md. Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are the result of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

In the Bolen test several drops of blood, obtained from the tip of a finger, are placed on a glass slide and allowed to dry. Examination is done with the low power of the microscope. A normal pattern shows an abundance of fibrin in an even mosaic field without vacuoles. Rouleaux formation is present but agglutination of the red blood cells is not seen. An abnormal pattern shows a decreased amount of fibrin and vacuoles in the field. Rouleaux formation is not present but agglutination of the red blood cells is seen.

Norman and Slicker,[3] using the Bolen test in over 350 patients, found the examination to be 97 per cent accurate. Bolen[2] reported 100 per cent accuracy in a group of 337 patients with benign lesions and 96.5 per cent in 198 patients with proven cancer. The statistics are better than those obtained by more complicated and expensive diagnostic procedures.

The blood of 303 patients admitted to the Veterans Administration Hospital was prepared and examined. Disagreement as to whether the test indicated a benign or malignant disease existed in fifty-four instances or 17.8 per cent. On several occasions one or more drops showed a typically normal pattern while the remainder demonstrated a positive pattern. All drops were of similar thickness. Differences of opinion were resolved by re-examination and discussion. Of 303 patients 228 did not show clinical evidence of cancer while seventy-five had malignancy as proven by biopsy or autopsy. In the 228 patients with benign disease the test was right in 172 (Fig. 1) and wrong in fifty-six (Fig. 2). This is an error of 24.5 per cent. In the seventy-five patients with proven cancer the test was right in thirty-five (Fig. 3) and wrong in forty (Fig. 4). This is an error of 53.3 per cent. In the group of 303 patients the test was right in 207 and wrong in ninety-six for an accuracy of 68.4 per cent. This is much less than can be expected from clinical examination. The high percentage of false positives and false negatives is disturbing in a test recommended for a screening purpose.

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Case Reports

SUCCESSFUL DIRECT AORTIC EMBOLECTOMY*

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NINE successful direct aortotomies for aortic embolectomy have been reported in the literature to date. To these we wish to add one case, bringing the total to ten. A successful aortic embolectomy is described herein as complete restoration of circulation to both legs for a period of at least three weeks after operation, with no loss of tissue as a result of the disturbed circulation.

Various methods of removing aortic emboli have been tried. The preponderance of these have been done by some form of retrograde milking of the embolus from below. Catheters have been inserted from each opened femoral artery, the embolus has been milked from one common iliac artery over the aortic bifurcation to emerge through a single opening in the other common iliac artery and the aorta has been opened directly, as was done in this case. The high approaches have been both transperitoneal and retroperitoneal. Our approach was through a transverse lower abdominal incision. Most of the reported transperitoneal approaches were midline or paramedian incisions. There is no specific mention made in the literature of a transverse incision having been used.

Unless the aortic embolism is removed, most of these patients die with or without amputation. These people frequently must survive other embolic phenomenon in addition to their underlying cardiac disease.

CASE REPORT

H. C., a fifty-seven year old white woman, was admitted to Lakewood Hospital on March 12, 1950, with a chief complaint of "pain in the right leg."

Ten days prior to admission she had noticed a peculiar pressure sensation in her chest. This was associated with some shortness of breath, palpitation and nausea. The patient was vacationing in Florida at this time and did not see her physician until she returned home one week prior to admission. A diagnosis of auricular fibrillation was made and quinidine therapy started in an attempt to convert the fibrillation without success. She was subsequently digitalized. Approximately three hours prior to admission numbness, tingling and pain in the right leg suddenly developed.

The patient's past history was significant in that she had had several attacks of chorea as a young girl, the last one at nineteen years of age. She had also had a protracted illness of two months' duration as a child which was diagnosed scarlet fever.

Physical examination on admission revealed a well developed, well nourished white female lying flat in bed complaining of numbness, tingling and pain in the right leg and foot. The lungs were clear to auscultation and percussion. There was marked precordial activity, the left border of cardiac dulness was in the mid-clavicular line and there was a pulse deficit. The blood pressure was 125/70 and pulse rate 140 with an irregular irregularity and of varying amplitude. Examination of the abdomen revealed the liver to be slightly tender and one fingerbreadth below the right costal margin. Examination of the extremities showed cyanosis of the toes of the right foot with no definite line of demarcation. The temperature of the skin of the right leg below the knee was slightly less than that of the left to palpation. The dorsalis pedis, posterior tibial and popliteal pulsations were absent on the right and were weak on the left.

The patient was seen in consultation (N. W. T.) on admission and a diagnosis of

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arterial embolism to the right leg without block of any important artery was made. Conservative therapy was recommended. (Fig. 1.) Anticoagulant therapy with heparin and dicumarol,® 3 gr. of papaverine, every four hours, a bed cradle and a right lumbar sympathetic block at L1 with 40 cc. of 1 per cent novocain were suggested and carried out. Her response was good, and following the sympathetic block the color of the right leg returned to normal, the pain was relieved and a faint posterior tibial pulsation was palpable.

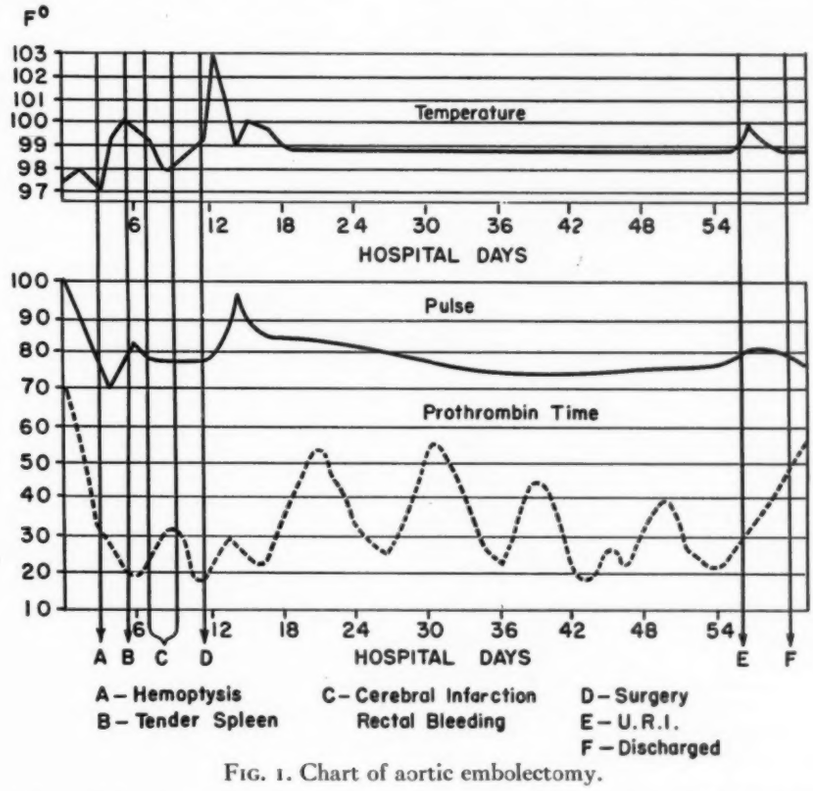

FIG. 1. Chart of aortic embolectomy.

On the third hospital day the patient had some recurrence of pain in her right foot, coughed up a large blood clot and had some right upper quadrant pain with nausea. The liver remained palpable and tender. Urinalysis revealed a rare red blood cell. On the fourth hospital day an electrocardiogram showed auricular fibrillation and slight digitalis effect. Left upper quadrant pain developed on the fifth hospital day and the spleen became palpable. Pain in the right leg had subsided and there was a very slight temperature differential between the right and the left leg. On the sixth hospital day some abdominal distention was seen and the patient began to pass some dark blood per rectum. A diagnosis of mesenteric embolism with incomplete block was made. After three days the melena stopped and the abdomen became normal. At the same time a change in her mental attitude suggested a cerebral infarct. There were no associated neurologic changes on physical examination. Her prothrombin time was maintained between 20 and 30 per cent of normal until her rectal bleeding occurred. At this time the prothrombin time was allowed to rise to 45 per cent of normal for two days, and with cessation of bleeding was returned to its former level.

At approximately 5:00 P.M. on the eleventh hospital day the patient suddenly had a sensation of heavy weight on both her legs. Shortly following this the sensation changed to pain, she was unable to move either extremity and a line of cyanosis began to develop immediately below the umbilicus. Neither femoral pulse could be obtained. The patient was taken to surgery within three hours; and while she was on the operating table, the line of demarcation was noted to have moved to immediately above the umbilicus. At the time of surgery the prothrombin time was 23 per cent of normal. Under general anesthesia a transverse

FIG. 2. Intact saddle embolus.

incision was made immediately below the umbilicus, the bowel was packed superiorly and the region of the sacral promontory was exposed. The peritoneum was incised and the aorta and common iliac arteries dissected free bluntly. Umbilical tapes were placed around the common iliacs and the aorta, and a longitudinal incision was made immediately above the bifurcation. A saddle embolus was removed intact. (Fig. 2.)

Following this procedure retrograde bleeding was obtained easily from the left common iliac artery but none from the right. An incision was made longitudinally in the right common iliac artery and catheters inserted here with removal of a small clot. Retrograde bleeding was not as satisfactory from this side as from the left, however. The incisions were closed with horizontal interrupted mattress sutures of black silk. Following surgery a therapeutic spinal anesthesia was administered. The patient received 1 pint of blood while in the operating room and this was started when the aorta was opened. No unusual bleeding was encountered in spite of the high prothrombin time. No additional blood was given and dicumarol was continued the following morning.

The following day there was cyanosis of the right foot to the metatarsal area; the left leg and foot were normal. Therapeutic spinal anesthesia was again administered the day following surgery, with great improvement in the cyanosis of the foot. Seven days postoperatively a level could be noted returning in the mid-tarsal area and there was some edema of the right leg. It was believed further sympathetic blocks would be useless. However, the edema subsided and a foot drop ensued. An area of gangrene 1 cm. in diameter appeared on the tip of the great toe. Three weeks post-

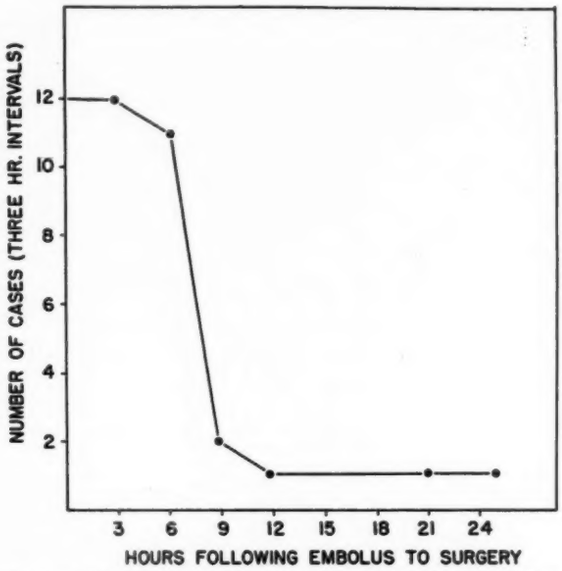

FIG. 3. The importance of early surgery in successful aortic embolectomy.

operatively oscillometric readings were equal bilaterally except at the ankle on the right where no deflection was recorded. Support for the foot drop on the right enabled the patient to walk and she was discharged on the fiftieth postoperative day.

COMMENTS

Thirty-four successful embolectomies have been performed, ten of these by direct aortotomy. (Table 1.) Of the direct aortotomies there is only one with a survival exceeding our patient, excluding those which were reported alive at the stated times with no subsequent follow-up.* There is also only one patient older than the one reported herein.

One case of aortectomy has been reported.[5] This was a young man shot in the chest, with subsequent migration of the bullet to the aortic bifurcation where it lodged, producing reactive aortitis. After five months resection of the aortic bifurcation was performed, with reported resultant improvement in collateral circulation.

* When last seen the patient was living and well twenty-seven months following embolectomy.

It is also of interest to note that one case of aortic embolectomy had no demonstrable cardiac pathologic condition. No source of embolus was ever found but there was a follow-up of only three months.

Twenty-four cases of aortic embolectomy concerning the type of arterial clamp or tourniquet that should be used during the procedure. In this case umbilical tapes were used by clamping them with a hemostat and then twisting the tape and retracting with it until no bleeding occurred. This accomplished the purpose very

TABLE I
SUCCESSFUL AORTIC EMBOLECTOMY

Author	Hours	Age	Result	Author	Hours	Age	Result
Direct Aortotomy:				Retrograde Milking:			
Bauer (2)	3	39	D—2.5 yr.	Key (11)	23	44	D—10.5 yr.
Thiessen	3	57	L—15 mo.	Lund (12)	9	34	L—5.5 yr.
Dreverman (3)	6	44	L—1 yr.	Westerborn (13)*	6	56	D—5 yr.
Albright and Leonard (1)	1.5	65	L—10 mo.	Murray (14)	....	27	L—3.5 yr.
Usadel (4)	.5	44	L—9 mo.	Ravdin and Wood	3	32	L—3 yr.
Agar (5)	2	28	L—5 mo.	Murray (14)	....	19	D—2.5 yr.
Madden (6)	5	52	D—3 mo.	Murray (14)	....	48	D—2 yr.
Gohrbandt (7)	5	39	L—5 wk.	Keeley (17)	6	52	L—23 mo.
Lindren (8)	10	41	L—5 wk.	Linton (15)	3	39	L—16 mo.
Walzel (9)	1	38	D—25 da.	Taylor (16)	6	30	D—14 mo.
				Nystrom (18)*	.5	56	R—9 mo.
				Burgess and Hartwell (19)	1	41	L—9 mo.
				Tendler (20)	3.5	36	L—4.5 mo.
				Murray (14)	21	38	D—4 mo.
				Linton and Warren (21)	8	56	D—3 mo.
				Jefferson (22)	6	25	D—3 mo.
				Culmone (23)	4	50	L—3 mo.
				Griffiths (24)	25	25	D—3 mo.
				Wilson (25)†	5	57	L—3 mo.
				Stegemann (26)	4	55	D—3 mo.+
				Kaps (27)	2	46	D—2 mo.
				Schmorell (28, 29)	....	66	L—5 wk.
				Gamble (30)	2	68	D—3 wk.
Aortectomy:							
Copper, Harris and Kahn (10)	5 mo.	22	L—5 mo.				

* Same patient.
† Normal heart.
D = dead; L = living; R = recurrence.

through various types of femoral and iliac incisions are reported. None of these exceed this report in survival; two patients were older than our patient. One of these patients was operated upon, had a recurrence in nine months with reoperation and a subsequent five-year survival.

The importance of the time interval between onset of the embolus and time of surgery should be stressed. Most of the successful embolectomies are performed within six hours following the onset; over six hours the mortality rises and the number of survivals drops sharply. In Figure 3 an attempt is made to show this graphically. The number of reported survived patients operated upon within three hours or less are plotted at three, those between three and six at six, and so on. Of the thirty-four patients undergoing embolectomies only six were operated upon later than six hours following the onset.

There has been considerable discussion concerning the type of arterial clamp or tourniquet that should be used during the procedure. In this case umbilical tapes were used by clamping them with a hemostat and then twisting the tape and retracting with it until no bleeding occurred. This accomplished the purpose very satisfactorily. Tourniquets were applied to the common iliacs as low as possible after the aorta was opened, hoping thus to prevent breaking off tails or extensions of the saddle embolus. Much has been written in the literature concerning this and it is questionable whether the application of tourniquets might break off extensions or whether they might prevent, in early cases, passage of a portion of the saddle embolus which may be broken off in the manipulation of its removal. It would seem that in early cases, under three hours, when the clot has not had much time to progagate and especially when the patient is already under adequate anticoagulant therapy, application of tourniquets on the common iliacs before aortic incision would be a wise procedure.

It is often impossible to differentiate clinically between thrombosis and embolism. We have performed another direct aortotomy. This patient with arteriosclerotic heart disease had the cardinal signs and symptoms of ob-

struction at the bifurcation of the aorta. The patient died forty-eight hours postoperatively of bronchopneumonia and a cerebral-vascular accident. At autopsy no source of an embolus could be found and it was believed that the aortic block had been more probably due to thrombosis than an embolus. Anticoagulants, however, failed to benefit the patient and at autopsy the clot was shown to have reformed. This case is not included in the series.

SUMMARY

1. A case of successful direct aortotomy for embolus is reported, with the patient living when last seen twenty-seven months postoperatively.

2. The cases reported in the literature to date and termed successful are reviewed.

3. The transperitoneal transverse lower abdominal approach is reported and recommended.

4. The importance of early surgery for aortic emboli is emphasized.

5. A case of aortic thrombosis with removal of the thrombus is mentioned.

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ACUTE TENSION PNEUMOPERITONEUM CAUSING TENSION PNEUMOMEDIASTINUM

A PRELIMINARY REPORT

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THE relaxation required for celiotomy produces a temporary increase in the potential capacity of the abdomen. Once the abdominal cavity is opened intra-abdominal air pockets form wherever viscera are separated from normal contact. The operative field in many cases is an artificial intra-abdominal air pocket. To express all such air pockets before closure is not possible; Pruvot[1] has emphasized that frequently no attempt is made to do so. Therefore, in the course of every abdominal section a quantity of air is sealed within the abdomen.

Difficulty in closing an abdomen, even with spinal anesthesia, is due at times to the fact that the wound edges must be approximated over a mass of air in addition to the viscera. When the quantity of air sealed into the abdomen is great, the return of normal tonus to the abdominal musculature creates a condition which might be termed acute tension pneumoperitoneum, as the belly wall tightens on the trapped air.

Bannon[2] has collected a series of roentgenograms which demonstrates very well the disposition of air within the abdomen after surgery. A study of his pictures shows that the magnitude of a postoperative pneumoperitoneum, in some cases, may be comparable to the quantities of air introduced into the peritoneal cavity by pthisiologists treating pulmonary tuberculosis.

Air cautiously introduced into the peritoneal cavity occasionally causes mediastinal emphysema. Depending upon the extent to which the mediastinal viscera are adherent to each other, gas in this region produces two main types of pneumomediastinum. When adhesions are negligible, benign air block occurs. If they are extensive and tough, however, tension pneumomediastinum takes place provided the quantity of gas is significant. Variations in the quantity of gas and the nature of the adhesions produce intermediate forms of this condition.

Mediastinal emphysema presents an obscure and variable clinical picture which has caused its diagnosis to be largely overlooked, and it is probably more common after celiotomy than is believed. Accordingly, the following case reports may be of interest:

CASE REPORTS

CASE I. A white female, age fifty-three, in good condition preoperatively, underwent exploratory laparotomy with cyclopropane and ether anesthesia (without intubation). A fibroid uterus was removed. The operation was uneventful and the patient returned to bed. Ten minutes later she exhibited generalized cyanosis of sudden onset and unknown origin. Examination of the heart, chest and respiratory passages revealed only an atelectatic area on the right side too small to explain the cyanosis. Inflation of the lungs through a cuffed endotracheal tube with oxygen failed to improve her color. Oxygen therapy was continued and the cyanosis gradually receded over a period of five days. Apart from the cyanosis her postoperative condition and progress were satisfactory.

Comment. Although the cause of this cyanosis appearing within minutes after the operation remains obscure, the most probable explanation is that it was a benign case of air block.

Atelectasis is common after celiotomy and one of the explanations advanced is that pulmonic interstitial emphysema develops giving rise to pneumomediastinum. However, Rubin[3] mentions rupture of an abdominal viscus with escape of gas via the retroperitoneal space into the mediastinum as a cause of pneumomediastinum. Evans and Smalldon[4] recorded this condition following abdominal section. They present two such cases wherein gas in the mediastinum came from below the diaphragm although they did not explain the source of the gas.

CASE II. This offers a new explanation for

the occurrence of atelectasis and mediastinal emphysema following laporotomy as noted by Evans and Smalldon.

A white male, age forty-eight years, was admitted to St. Catherine's Hospital, New York City, on September 18, 1949, with a provisional diagnosis of chronic cholecystitis and cholelithiasis which was confirmed by routine investigation. The patient's history disclosed a severe attack of pneumonia nine years earlier. Physical examination revealed moderate tenderness in the right upper abdominal quadrant but otherwise the patient appeared in good health. Blood pressure was 100/68. At 8.00 A.M. the patient received preoperatively morphine sulfate ¼ gr. and atropine sulfate $\frac{1}{150}$ gr. At 9.00 A.M. anesthesia was started with cyclopropane for induction. Forty units of curare were injected intravenously and an endotracheal tube inserted through the mouth under direct vision without difficulty. The abdomen was opened and a chronically inflamed gallbladder was removed by peeling dissection. In the process of suturing the peritoneum there was a pause to demonstrate the relaxation present in the abdominal wall. The partly sutured incision was raised vertically, thereby creating a tent-like space. Thus when the peritoneum was closed, an unusually large quantity of air was trapped within the peritoneal cavity. Except for transient bronchospasm, the procedure was uneventful. The operation was completed at 10.00 A.M. and the patient was put to bed at 10.15 A.M. At 10.27 A.M. the patient coughed, became extremely cyanosed, respiration stopped and the radial pulse was imperceptible. Blood pressure could not be determined nor the heart sounds heard over the precordium; the pupils were pinpoint in size. Artificial respiration and intravenous coramine were administered and respiration returned with a systolic pressure of 70 and a pulse rate of 60. Careful examination yielded no evidence that aspiration of vomitus was a factor in causing the patient's unusual condition.

From 11.00 A.M. to 1.00 P.M. the patient was conscious. The generalized cyanosis remained, although less marked; the pupils were still constricted and the blood pressure 120/68. His face was peculiarly black. At 1.00 P.M. and at 3.45 P.M. the patient suffered similar collapses to the first episode but with decreasing severity. At 5.00 P.M. an anteroposterior roentgenogram of the chest was taken at the bedside (with the patient sitting up) which showed a radiolucent area along the left border of the mediastinum, devoid of lung markings (indicative of mediastinal emphysema). The trachea was in the midline and a small atelectasis present on the right side. The diaphragm seemed unusually high on both sides.

On the first postoperative day at 1:30 P.M. the patient's condition had deteriorated. There was severe pain in the region of the xiphoid with a sensation of constriction in the lower chest. The cyanosis had become very marked, aside from the persistently black facies, and the patient was unable or unwilling to cough. Physical and x-ray examination revealed the digestive tract was distended. There was no apparent change in this condition during the day but slow improvement took place over the succeeding four days. The cyanosis and substernal pain was gone by the end of the first week, but the singular blackness of his facies receded very slowly, taking over two weeks to clear up. The patient was discharged in good condition three weeks after the operation.

Comment. From the foregoing events the following explanation becomes possible: A quantity of air was sealed into the peritoneal cavity during the operation. At first this produced no apparent effect. However, as the relaxation in the abdominal wall wore off, pressure within the abdominal cavity began to rise producing the acute tension pneumoperitoneum. When the patient coughed following his return to bed, he suddenly increased the intra-abdominal pressure still further, driving a quantity of air along the great vessels or esophagus through the diaphragm upward into the mediastinum. This sudden blast of air upon the vagi nerves within the close confines of the mediastinum arrested the heart and respirations at once, in the same manner as do the manipulations of a surgeon working in that region.[5]

The heart and lungs resumed function each time spontaneously as the air became distributed more evenly throughout the mediastinum. The continued presence of air within this space constituted a constant source of irritation to the contained vagi nerves which was shown by the persistently constricted pupils, the bradycardia and perhaps the atelectasis. The generalized cyanosis, therefore, was due to the pressure of this air on the great vessels impeding the circulation, a condition which could

not be influenced by giving pure oxygen inhalations.

The black appearance of the facies was due to sudden waves of back pressure travelling from the violently compressed right heart and superior vena cava backward up into the valveless veins of the neck and head. These sudden waves of back pressure in the veins forced some of the contained blood to rupture through the capillary walls. This extravasation produced ecchymoses throughout the tissues of the neck and head. The eyelids were especially dark due to the fact that veins in the eyelids are supported only by very loose tissues. This discoloration, being due to extravascular hemoglobin, was unaffected by the patient's degree of oxygenation. The appearance of the facies was, therefore, produced by the mechanism of traumatic asphyxia.[6,7]

Three insults had occurred, the sequence of events being the same in each case. A cough[8] caused a sudden rise in intra-abdominal pressure; this was followed immediately with extreme cyanosis and cardiac arrest as indicated by the disappearance of the pulse, blood pressure and heart sounds. Spontaneous improvement followed when the blood pressure was found to be within normal limits, the pulse slow and full, and the pupils constricted.

The decline in his condition on the first postoperative day following the initial improvement was due to the abdominal distention. The distention which occurred in the gastrointestinal tract slowly forced more air from the abdomen up into his mediastinum. Since this was a gradual process, it produced generalized cyanosis with severe substernal pain, whereas the cardiac phenomena seen the day before were associated with air entering the mediastinum in an explosive manner. His recovery occurred over a period which corresponds approximately to the time taken for a small pneumothorax or pneumoperitoneum to be absorbed.

The possibility that the pneumomediastinum arose from trauma to the trachea by the endotracheal tube was dismissed since surgical emphysema was not present in the neck. Gases in the lung can escape from a ruptured marginal alveolus along a blood vessel into the mediastinum when positive pressure is used according to the Macklins.[9] However, in this case there was no evidence to indicate the presence of pulmonic interstitial emphysema.

Case III. In an elderly male, following bowel resection, a fistula developed on the ninth day. The abdominal wound burst open on the eleventh day and immediate secondary closure was effected under spinal anesthesia. At operation a perforation of the gut was found with peritonitis, meteorism and malodorous fluid in the peritoneal cavity. The procedure was prolonged and, with much difficulty, the belly wall was closed with wire. As the patient was put to bed, generalized cyanosis suddenly developed.

Oxygen was administered at once through an endotracheal tube, but this failed to relieve his cyanosis although his cardiac output and respiratory movements appeared adequate. Auscultation of his chest revealed diffuse crepitations. By having him hold his breath it was shown that these sounds were related to the cardiac contractions (Hamman's sign).

The patient complained chiefly of dysphagia, a symptom noted by Banyai (when pneumoperitoneum was complicated by pneumomediastinum), until his death four days later from the effects of abdominal disproportion.[12]

Comment. In the light of Case II the following points are now significant: (1) Perforation of the gut means free gas in the abdomen; (2) laparotomy introduces air; (3) since force was necessary to close the belly, the pneumoperitoneum must have been under considerable pressure when muscle tone returned; (4) atelectasis was present in both lower lobes.

REMARKS

The diagnosis of air block is not difficult when it is known that the possibility of air entering there exists, e.g., wounds of the neck, or following a pneumoperitoneum treatment. Surgical emphysema in the neck provides an excellent clue when noted. That air remaining in an abdomen after a laparotomy constitutes a possible cause of pneumomediastinum is not generally recognized, but in every case showing unexplained generalized cyanosis this possibility should be explored.

The surgeon entering the peritoneal cavity must also open the posterior peritoneum, all organs being in the retroperitoneal space. Therefore, besides a pneumoperitoneum he leaves a potential exit whence air can escape into the viscero-vascular space.

In the living subject x-ray constitutes a most useful and conclusive investigation in these

cases. The ease with which this condition may be demonstrated on a roentgenogram depends on the quantity of air present and the extent to which this air can separate the mediastinal structures normally in contact. The untoward effects of this condition, on the other hand, are not directly related to the manner in which it shows up on the x-ray and in many cases it cannot be shown radiologically.[10]

Obviously, if the mediastinal structures are adherent, the air cannot cause extensive separation, and in such cases it may cause severe localized pressure effects even if the quantity of air be small, i.e., tension pneumomediastinum.[11]

If air were not invisible, acute tension pneumoperitoneum (alone or in association with the various related conditions)[12, 13] would surely have received more consideration. However, unless one were seeking gas in the abdomen, other than within the intestine, i.e., in the peritoneal cavity or the retroperitoneal space, its presence would be difficult to detect clinically or at autopsy. Likewise air in the mediastinum tends to pass unnoticed or to be confused with air in the lungs.

According to Banyai,[14] Overholt[15] and others, gas in the abdomen might cause atelectasis by splinting the diaphragm or impairing the drainage of a bronchus or bronchiole. Air in the mediastinum could cause atelectasis by mechanical compression of lung tissue or perhaps by vagal irritation, a possibility suggested by the work of De Takats,[16] Pallin[17] and Xalabarder.[18] The sudden onset and rapid disappearance of an atelectatic area (in the absence of a mucus plug) is consistent with vagal spasm of the bronchioles and alveoli in the affected area.

In view of these considerations it appears that the pneumoperitoneum, present following an intra-abdominal operation, is an etiologic factor in the production of the associated pulmonary complications.

Foregger[19] and others have reported a number of fatalities and complications in patients subjected to celiotomy. Many of these cases, attributed to curare, were extremely suggestive of pneumomediastinum. Unless this condition be carefully excluded, such disasters can hardly be ascribed to curare alone.

Beckhert, Fisher and Harroun[20] describe what they call a "typical case history of a death from curare" as follows: "A man of forty is sent to surgery for an elective cholecystectomy. He is put to sleep with thiopental sodium, and cyclopropane and oxygen are administered. When the peritoneum is opened, the patient is insufficiently relaxed. Curare is administered and immediately relaxation becomes adequate. To facilitate closure of the peritoneum more curare is given. At the end of the operation the patient is in good condition, well oxygenated, breathing spontaneously, with a good pulse and blood pressure. He is returned to bed. Half an hour later he is found dead. Postmortem examination shows atelectasis of both lungs."

This "typical" case history bears a remarkable resemblance to Case II described earlier, and in our opinion this "typical" case history may in some cases be that of air block with reflex atelectasis and cardiac arrest due to postoperative "acute tension pneumoperitoneum."

The magnitude of the pneumoperitoneum is related to the increase in the abdominal capacity, and also the extent to which the viscera are disturbed, as air pockets form whenever surfaces normally in contact are separated. That cholecystectomy is the operation in the "typical" case is simply because this common procedure requires a roomy abdomen and involves much disturbance of the viscera.

Certainly it is notable that the period of thirty minutes, approximately, between the conclusion of the operation and the subsequent collapse in the "typical" case corresponds to the time taken for normal tonus to return to the relaxed anterior abdominal wall. In Case II previously described collapse occurred twenty-seven minutes after surgery was concluded.

Artificial pneumothorax can cause sudden and even fatal collapse due to air embolism.[21] Therapeutic pneumoperitoneum is attended by the same hazard.[22] The danger of air embolism in chest surgery has been noted.[23] Since many blood vessels are opened during celiotomy and acute tension pneumoperitoneum occurs, the incidence of air embolism complicating this procedure is probably higher than in those subjected to artificial pneumothorax or pneumoperitoneum. This condition should therefore be included in the differential diagnosis of obscure and dramatic complications attending laparotomy.

The report of Jolleys[24] indicates that the law of the abdomen, which states that "The belly must not alone contain its viscera, but should also fit them, while the latter should

embarrass neither their host nor fellows," requires emphasis.

SUMMARY

1. Three cases of mediastinal emphysema following the introduction of air into the abdominal cavity during celiotomy are described.

2. The etiology and diagnosis are discussed.

3. Certain features common to these and other reported cases of collapse in the immediate postoperative period are emphasized.

4. That pneumomediastinum be considered in the diagnosis of patients showing generalized cyanosis of unknown origin, also postoperative atelectasis, is suggested.

5. Attention is directed to the possibility of air embolism complicating celiotomy, and the law of the abdomen is emphasized.

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NON-TRAUMATIC DIAPHRAGMATIC HERNIA WITH COMPLETE EVISCERATION OF THE LIVER

REPAIR WITH TANTALUM WIRE MESH

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THE subject of diaphragmatic hernia has been quite thoroughly discussed in the surgical literature. Various classifications of the different types have been proposed.[1-3,8] There is general agreement that the various types of diaphragmatic hernia may be satisfactorily divided into two main groups based on the etiologic factor, namely, traumatic and non-traumatic.

Traumatic hernia may be caused by direct or indirect violence or by inflammatory necrosis, and may occur at any point of the diaphragm.

Non-traumatic hernia occurs more commonly at certain sites because of the unusual embryologic formation of the diaphragm. These sites in relative order of frequency of herniation are:[1] (1) the esophageal hiatus, (2) the pleuroperitoneal hiatus (foramen of Bochdalek), (3) the anterior substernal opening (foramen of Morgagni or Larrey's space) and (4) the gap left by partial absence of the diaphragm (usually posterior).

Non-traumatic diaphragmatic hernia may be congenital or may be acquired following birth. Congenital defects are far more common in the left side of the diaphragm;[4] Harrington[2] found only one right-sided hernia in a series of 404 cases of diaphragmatic hernia treated surgically. Acquisition of non-traumatic diaphragmatic hernia implies the existence of a congenital diaphragmatic defect, with herniation of a viscus through this defect at some later time. It is often difficult to determine whether the hernia has been recently acquired or whether such hernia has been present but unrecognized since birth. The presence or absence of a hernial sac is of some aid in differentiation, as in congenital hernia no sac is present whereas a sac is often present in acquired hernia.

The symptoms of diaphragmatic hernia are complex because of the various structures involved and because of the degree of mechanical interference with the function of the herniated viscera or on diminished pulmonary function.

Many abdominal viscera have been described as comprising the content of diaphragmatic hernias. The stomach is the most common, with colon and small intestine next in order of frequency. The spleen and kidney have been reported as components of hernia. The liver has been recorded as herniating through the diaphragm but in most instances this has been described as lobular rather than total. Kleitsch[5] in 1949 described a case of total evisceration of the liver and reported that search of the literature at that time failed to reveal a previously described case of total evisceration of this organ.

The following case report is of interest in that it presents the unusual occurrence of a non-traumatic diaphragmatic hernia in an elderly adult, reports the rare existence of total evisceration of the liver, stimulates speculation as to the manner of occurrence and describes a satisfactory type of repair employing tantalum wire mesh.

CASE REPORT

A seventy year old white man was admitted to the Harrisburg Hospital on October 6, 1950, complaining of pain in the abdomen and chest and shortness of breath. Sixteen hours before admission, without antecedent illness or trauma, pain suddenly developed in the right upper quadrant of the abdomen while the patient was lying in bed. Following this onset the pain persisted and gradually became more severe, being described as a "feeling of a tight band around the lower chest." The patient felt bloated and nauseated but did not vomit. About four hours before admission he became progressively short of breath and blueness of the lips and nails developed.

The patient stated that he was a retired railroad worker who had always enjoyed excellent health. He denied any previous illnesses, accidents or operations. The family history and systemic review were non-contributory.

Physical examination revealed a well developed, elderly white man lying restlessly in bed, complaining of shortness of breath and pain in the chest and abdomen. His temperature was 99.6°F., the pulse rate 100 per minute, the blood pressure 140/90 mm. Hg and the respirations 34 per minute. There was grade III cyanosis of the lips and nail beds. No abnormalities of the head or neck were present. Heart tones were of good quality, the rate regular and no murmurs were heard. Percussion of the chest revealed dullness over the lower right chest posteriorly, with a rather tympanitic note over the anterior aspect. No breath sounds were audible over the right lung field. The left lung was entirely clear to percussion and auscultation. The abdomen was moderately distended and tense, with muscle guarding and grade II tenderness in the right upper quadrant. No masses were palpable. Peristalsis was hypoactive, only an occasional faint tone being audible. The remainder of the physical examination was essentially negative.

The red blood cell count was 4,510,000 per cu. mm., with 14.0 gm. (91 per cent hemoglobin. The leukocyte count was 9,650 per cu. cm., with 70 per cent polymorphonuclear cells and 30 per cent lymphocytes. The erythrocyte sedimentation rate was 52 mm. per hour. The blood urea was 50 mg. per 100 cc. The Kline test for syphilis was negative.

X-ray of the chest and a plain scout film of the abdomen in the supine and upright positions revealed a dilated gas-filled loop of bowel extending into the right thoracic cavity as high as the arch of the aorta with several small shadows lying beneath the larger loop. There was a shift of the heart and mediastinum to the left. The left lung field was normal. (Fig. 1.)

A diagnosis of right diaphragmatic hernia was made and the patient was treated with oxygen, intravenous fluids, gastric suction through a Levine tube and sedation. His general condition improved but he continued to complain of rather severe pain below the right costal margin. His abdomen became more tense and distended and peristalsis became hyperactive and was clearly audible over the entire right chest. About thirty-six hours after admission there was a rise of the temperature and pulse curves with increasing abdominal distress and distention. It was believed that intestinal obstruction was impending and immediate surgery was deemed advisable.

FIG. 1. Preoperative chest x-ray showing loops of bowel in right thoracic cavity.

A right thoracotomy was performed under nitrous oxide-oxygen-ether anesthesia administered through an intratracheal tube. The thorax was opened through the eighth intercostal space, dividing the ninth rib at its costovertebral angle. The right thoracic cavity was almost completely filled with abdominal viscera consisting of the entire liver, transverse colon and approximately one-third of the small intestine. The posterior aspect of the diaphragm was entirely absent and only a thin rim of the anterior portion was present, measuring 5 cm. at its widest point. There was no movement of this remnant. The entire liver was lying within the thoracic cavity, having rotated upward 180 degrees so that its inferior surface lay anterior, with the gallbladder lying prominently near the apex of the thorax and the duodenohepatic omentum clearly exposed throughout its entire extent. The liver was attached only at its posterior surface by the coronary and triangular ligaments. The entire dilated transverse colon and mesocolon lay anterior to the liver, with a number of loops of small intestine lying below the colon. No definite hernial sac was present. A number of rather fine adhesions were present between the abdominal viscera and the parietal pleura, and a small amount of straw-colored fluid was present at the base of the thoracic cavity. (Fig. 2.)

An attempt was made to reduce the hernia through the diaphragmatic defect but this

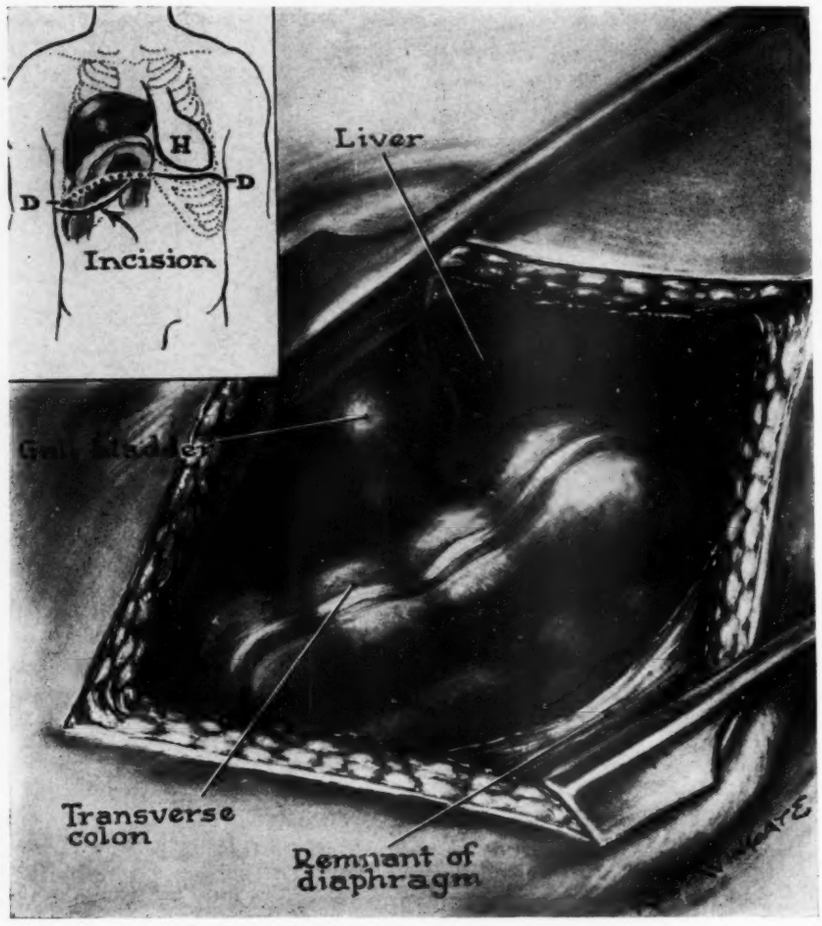

FIG. 2. Artist's drawing of operative findings.

met with difficulty because of the marked dilatation of the colon. The thoracic incision was then carried anteriorly through the costal cartilage and the remaining anterior portion of the diaphragm divided. The loops of small and large bowel were then replaced without undue difficulty, following which the liver was rotated downward into its normal position. The severed margins of the narrow anterior diaphragmatic remnant were approximated with interrupted silk mattress sutures. This left an ovoid diaphragmatic defect which measured approximately 14 by 10 cm. in area. A piece of tantalum wire mesh was cut to approximate this defect allowing an overlap at the edges, and this patch was sutured into place over the diaphragmatic defect by means of horizontal mattress sutures of silk. The resultant closure obliterated the diaphragmatic defect completely and was accomplished without tension. The right lung was completely re-expanded and the thoracicoabdominal incision was closed in layers with interrupted chromic catgut sutures and silk skin sutures. A rubber catheter was brought out through the posterior angle of the incision and connected to a water-sealed drainage bottle. Penicillin, 500,000 units dissolved in 30 cc. of sterile water, was injected into the thoracic cavity through the clamped tube. The patient received 1,000 cc. of whole blood during the operative procedure, which he withstood without incident.

The patient's postoperative course was entirely uneventful. The drainage catheter was removed in twenty-four hours and the patient was made ambulant at this time. X-ray examination of the chest revealed the right lung to be completely re-expanded and the tantalum mesh patch to be in good position. (Fig. 3.) There was no motion of the right diaphragm. The operative wound healed per primam and the patient was discharged from the hospital ten days after operation.

He has been examined at intervals since his

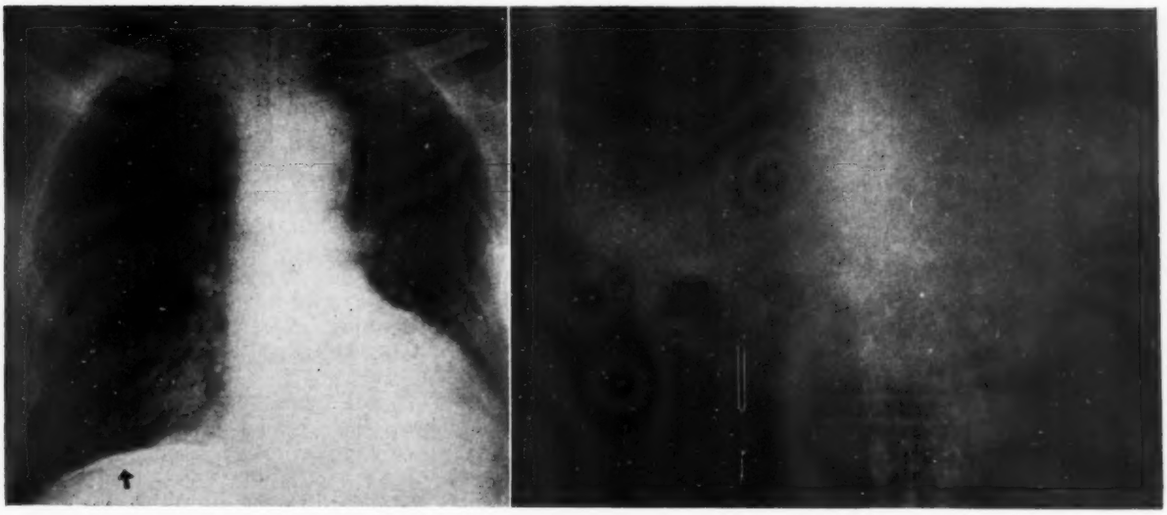

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FIG. 3. Immediate postoperative x-ray of chest showing tantalum mesh patch in right diaphragm (arrow).

FIG. 4. X-ray film one year postoperatively; oblique view from below showing right diaphragmatic area and appearance of tantalum mesh patch.

discharge from the hospital. When last seen, one year after operation, he stated that he was in excellent health with no complaints referable to the respiratory or gastrointestinal systems. Auscultation of the chest revealed no abnormalities. At fluoroscopy there was still only paradoxic movement of the right diaphragm. X-ray of the chest revealed the tantulum mesh patch to be in the same position as on the first postoperative x-ray. No abnormalities of either lung field were visible. (Fig. 4.)

COMMENTS

Of primary interest is a consideration of the causal mechanism of this hernia. In view of the extensive defect present in the right diaphragm and of a negative history of trauma a congenital type of hernia must be assumed. It seems probable that this was of the type caused by congenital absence of the posterior aspect of the diaphragm or, possibly, through the pleuroperitoneal hiatus of the foramen of Bochdalek. Since the entire posterior aspect of the diaphragm was absent, it seems likely that the former type is the more accurate as to classification.

If this assumption is correct, how does one explain why this active, healthy individual with a large diaphragmatic defect could carry on his vigorous pursuits for seventy years only to have his abdominal viscera suddenly migrate into his thoracic cavity while lying quietly in bed? The presence of congenital defect must be assumed since there was no history of trauma or infection. Moreover, it seems logical to assume that the hernia was acquired suddenly; it seems highly improbable that the liver and intestinal viscera could be present within the thorax for many years without causing some distressing symptoms.

Although no attempt to explain the mechanism of occurrence must be hypothetical, it seems not illogical to assume that congenital absence of the posterior portion of the diaphragm was present since birth but that no hernia occurred because of the position of the liver which effectively closed the defect. Because of some unknown precipitating factor, and after many years of effectively plugging the diaphragmatic opening, the liver suddenly rotated itself upward through the hiatus, the posterior margin acting as a hinge. Following the evisceration of the liver into the thorax the intestinal viscera followed through the now unguarded opening.

The method of repair was discussed at some length prior to operation. It was anticipated that a large defect might be present which might require a graft to obtain obliteration. The use of a musculofascial flap such as described by Rives[6] and Parrella[7] was considered. The thigh was prepared for the taking of a fascial graft and tantalum wire mesh was made

readily available. At operation tantalum wire mesh seemed most adaptable to closing the defect and was selected rather than a free fascial graft because of the lack of a satisfactory vascular bed.

The reactions of tissues to tantalum mesh have been carefully described by Koontz.[9,10] Monahan[11] has reported a case of eventration of the diaphragm repaired with tantalum mesh in which no harmful effects to lung tissues were noted. Although we have encountered no reports in the literature of the employment of this material in the repair of actual diaphragmatic defects, the use of tantalum mesh in this instance has to date proved entirely satisfactory.

CONCLUSIONS

1. The types of diaphragmatic hernia have been briefly reviewed.

2. A case of non-traumatic, acquired diaphragmatic hernia with complete evisceration of the liver in an elderly adult is reported.

3. Satisfactory repair of this diaphragmatic hernia employing tantalum wire mesh is described.

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ANOMALY OF THE VAS DEFERENS*

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THE reported congenital anomalies of the testis are few in number and deal mainly with failure of union between the epididymis and the testis. Reference is made to Badenoch[1] and Brunzema[2] who found it four times in 104 cases of undescended testis. Kaufman[3] and Windholz[4] mentioned a complete separation of the epididymis and testis. Wilson[5] recorded one case in which the testis was in the inguinal canal and the epididymis was in the scrotum. Ombredanne[6] described separations occurring occasionally when there was a vestigial testis. Wangensteen[7] quoted a case of an epididymis with a vestigial structure attached to it which had none of the appearance of the testis. Hobday[8] mentioned that in the horse the epididymis is occasionally found in the inguinal canal while the testis is in the abdomen.

The case we wish to report represents a type of congenital anomaly which has not been reported in the literature, so far as we could ascertain. (Fig. 1.)

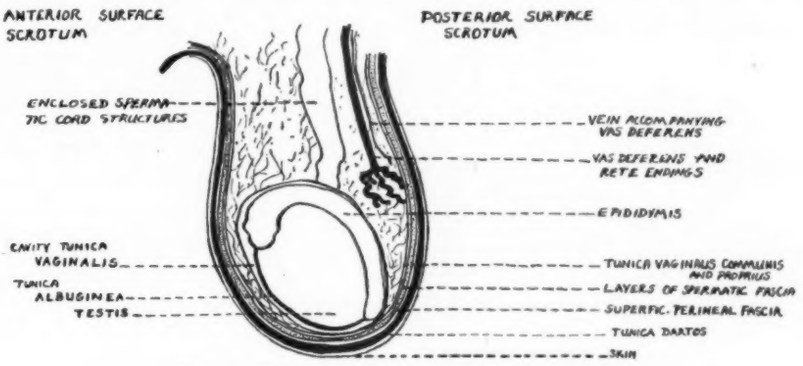

FIG. 1. Diagram of anomaly of vas deferens.

CASE REPORT

Mr. H. P. C., age fifty-seven, was admitted to the Touro Infirmary (No. 10627-50) on August 16, 1950, with a twenty-year history of a hernia of inguinal-scrotal type which had never incapacitated him in any way, including outdoor sports. Past history was non-contributory. He was the father of one child now thirty years old.

Physical examination revealed the following vital signs: blood pressure 120/70, pulse 80, respirations 20, temperature 98.6°F. Physical findings were within normal limits except for the presence of a large right inguinal-scrotal hernia which was easily reduced. Laboratory data including complete blood count, urine, chemistry and serology were normal.

Surgical procedure was as follows: An incision was made in the skin parallel to the ilio-inguinal ligament and carried through external oblique aponeurosis. After opening the inguinal canal, the entire hernial mass was brought into the wound. As the hernia was thought to be of congenital type, the sac was opened with the idea of creating a proximal and a distal sac from within. The proximal sac was isolated and a purse-string suture placed from within the sac and reinforced by a transfixing ligature to obliterate the internal opening. In attempting to isolate the vas deferens in the distal sac it was found that the vas ended in rete fashion into the inferior portion of the tunica vaginalis and was accompanied by a large vein. The spermatic cord was identified. The cremasteric muscle fibers and infundibuliform fascia were separated and the cord was found to contain no

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vas deferens. All other spermatic structures, the testicle and epididymis were intact.

At operation, with the idea of preventing a postoperative hydrocele and obtaining a more secure hernioplasty, an orchidectomy with removal of the cord was done. The pathologist's report confirms the fact that the vas deferens did not communicate with the epididymis.

In repair of the inguinal canal the transversalis fascia was approximated to the ilioinguinal ligament with interrupted cotton sutures. The external oblique aponeurosis was reapproximated with interrupted sutures; the superficial fat and fascia closed with interrupted catgut sutures; the skin was closed with Michel clips. Postoperative course was uneventful.

COMMENTS

In an attempt to explain the anatomic defect, standard textbooks on embryology were of no avail. We could find no similar cases in the literature. In reviewing the embryology of the genital tract one finds the following: The mesonephron forms a strong projection into the body cavity from the posterior wall of the abdomen. On the medial surface of the peritoneum, which covers it, a thickening appears which is termed the genital ridge. The upper part of the ridge becomes the testis, while the remainder becomes the gubernaculum. As the testis develops, the upper part of the Wolffian body (mesonephron) enters in relation with the testis and direct union with the seminiferous tubules. The Wolffian body then divides into a reproductive and excretory portion; when the metanephron (permanent kidney) develops, the excretory portion of the Wolffian body degenerates, leaving a few tubules as the vas aberrans and paradidymis. The reproductive portion forms the tubules of the epididymis and serves to transport the spermatozoa to the Wolffian duct. The Wolffian duct persists (in the male) to form the vas deferens of which the seminal vesicle is an out pouching and the ejaculatory duct a continuation.

The explanation of this reported anomaly seems to lie in the similarity in the development between the gastrointestinal tract and the Wolffian duct. Both begin as a solid structure which becomes tubular, later solid, and finally tubular again. It is well known that one may find two blind ends of small bowel with no evidence of connection. This is explainable on the basis of an area of atresia forming a narrow band connecting the two segments of bowel. As the infant grows the weight of intestine is of sufficient distracting force to tear this cord in two. We believe that a similar area of atresia occurred in the Wolffian duct of this patient and that the forces involved in the descent of the testicle were sufficient to cause a complete severance of the atresic portion of the vas deferens, resulting in a vas deferens which did not communicate with the epididymis.

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New Instruments

A NEW AID IN THE MANAGEMENT OF COLLES' FRACTURE

E. Sherburne Lovell, M.D.
Springfield, Vermont

THE frequency with which the physician or surgeon is called upon to treat the common Colles' fracture and the disability or deformity which all too often follows its treatment are constant reminders that there may still be considerable room for improvement in our methods. It is the purpose of this brief paper to present the details of a device which would seem to obviate some of the disadvantages of certain common methods of handling this fracture.

Reduction of Colles' fracture is commonly carried out manually with the surgeon using both hands for traction and countertraction, breaking up the impaction and restoring the fragments to their normal position. Countertraction may be provided by an assistant, or indeed (spring-balance traction and countertraction) is used by some men for the reduction itself and maintenance of position during application of the immobilizing medium. Except in the latter instance, plaster is applied by the surgeon while still trying to hold the reduction, or by an assistant trained in the use of plaster while the surgeon concentrates on the reduction alone. Postreduction x-rays may or may not be taken during this phase. The means of immobilization varies widely over the country, including metal splints, dorsal or dorsal-volar plaster splints, circular casts to either below or above the elbow and so-called sugar-tong plaster splints. The position of immobilization is sometimes extreme as in the Cotton-Loder position of acute flexion, with ulnar deviation and pronation, or more commonly is some less extreme modification even approaching the neutral position.

For some time I have thought that the usual methods of handling this fracture fail to provide satisfactory means for maintaining reduction during the application of plaster and that often loss of position results, the forerunner of an unsatisfactory result. The apparatus herein described was designed primarily to overcome this deficiency. It incidentally provides several other desirable features.

The Colles' fracture frame (Fig. 1) is basically a portable device which may be clamped

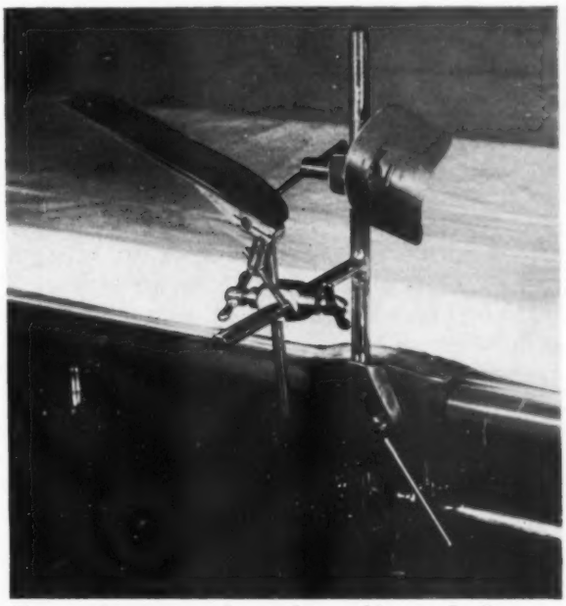

Fig. 1. Apparatus clamped to table, ready for use. Manner of adjustment of various parts is clearly seen. Padding has been removed from upper arm rest to show construction detail.

to almost any table, supporting a vertical metal rod from which extends a similar horizontal rod. Attached to the upright rod is an adjustable, padded, slightly concave metal plate against which the patient's arm is held, thus providing unassisted countertraction. (Fig. 2.) Supported by the horizontal rod is a thin, slightly concave metal splint for support of the forearm. This is adjustable by means of a lock nut to any height and in either vertical or horizontal planes. (Figs. 1 and 2.) It is readily detachable from its upright support.

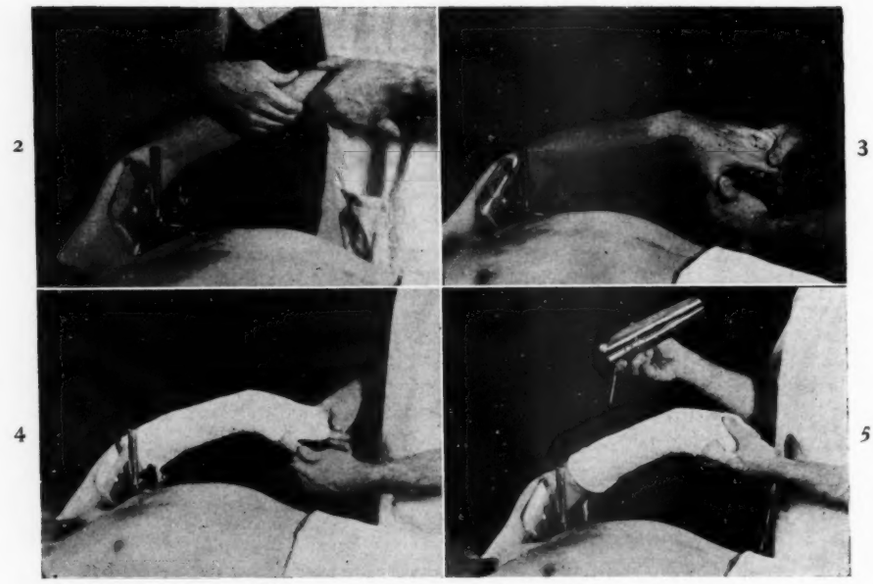

FIG. 2. Reduction of fracture; upper arm rest provides countertraction.

FIG. 3. Maintenance of reduction in desired position after lowering forearm onto forearm rest. X-rays may be taken in both planes at this time.

FIG. 4. Cast applied while reduction is maintained; forearm rest included in plaster.

FIG. 5. After plaster has set, forearm rest is detached and removed from beneath cast. If cast is to extend above elbow, it is completed at this time.

The use of the frame is best depicted in Figures 2 to 5. The patient is placed on a suitable table. The frame is clamped to the appropriate side of the table (it is completely reversible for opposite extremities) at a level corresponding to the patient's arm abducted to 90 degrees. Adjustment is then made with the locking nut so that the padded upper arm rest is at the proper height and angle and the elbow extends slightly beyond its outer end. The forearm rest is then adjusted to support the forearm properly, with the wrist joint itself clearing the tip of the splint. This is important in consideration of the postreduction x-rays.

The patient is then anesthetized. The surgeon next reduces the fracture in the usual manner, *over* the forearm support. Valuable countertraction is afforded by the upper arm rest, obviating the necessity for an assistant at this point. The wrist and forearm are then lowered onto the forearm rest, the surgeon maintaining the desired position by grasping the patient's fingers in one hand and the thumb in the other. Anteroposterior and lateral x-rays may then be taken. If the reduction is unsatisfactory, the fracture is then remanipulated and more films are taken. Once satisfactory position has been attained, the holding of the patient's thumb and fingers may be delegated to *any* assistant, trained or untrained, and the surgeon is free to manage the immobilization.

If a below-elbow circular plaster cast is to be applied, stockinet or sheet wadding may be applied over the forearm *and the forearm rest* without disturbing the fracture. Plaster is then applied as desired to just below the elbow. It will be seen that the forearm rest does not interfere with this in any way, being little more than 1 mm. in thickness except at the most proximal portion. The plaster is then allowed to set, after which the forearm rest is detached from its supporting upright and is slid out from between the forearm and the plaster. For the surgeon who wishes an above-elbow cast it may be completed at this time. The apparatus is of relatively little help to the surgeon who insists on a sugar-tong plaster splint. Nevertheless, in such a case the forearm rest need not be utilized at all. The upper arm rest provides countertraction and a sugar-tong splint could be applied with the wrist and forearm held extended horizontally.

With the forearm rest entirely detached, the apparatus is helpful in providing countertraction for reduction of fractures of both

bones of the forearm. Postreduction films are readily obtained prior to application of plaster.

This apparatus has been used in the treatment of Colles' fractures for well over two years and has proved to be a valuable aid in these cases.

CONCLUSIONS

The obvious advantages of this fracture device over other methods of treating a Colles' fracture are as follows:

1. The reduced fracture is maintained in a stable manner while x-rays are taken and while plaster is being applied.

2. *One untrained assistant suffices.* His job is extremely simple.

3. Countertraction is provided, relieving the surgeon of producing both traction and countertraction himself.

4. The surgeon is free to apply the plaster himself instead of requiring a trained assistant.

GASTROINTESTINAL carcinoids originate in the chromargentaffin cells in the crypts of Lieberkühn. They have a marked affinity for silver stains and frequently undergo malignant degeneration. Although rare they are most often seen in the appendix. Here they are less apt to undergo malignant change with metastases (only 5 or 10 per cent) whereas a much larger percentage of carcinoid tumors of the stomach and the rest of the gastrointestinal tract manifest such malignant characteristics. (*Richard A. Leonardo, M.D.*)

PROBLEMS IN WET COLOSTOMY MANAGEMENT FOLLOWING RADICAL PELVIC SURGERY

USE OF A NEW GIANT BALLOON CATHETER

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THE increasing employment of radical surgery for the treatment of advanced pelvic carcinoma has resulted in new problems of postoperative care for this group of patients. Total excision of pelvic viscera, "pelvic viscerectomy or exenteration," including by definition a total cystectomy necessitates ureteral transplantation.[4,5] Although several surgeons[1,2] report considerable success with the creation of artificial cecal bladders, the majority of operators continue to prefer some method of ureterosigmoid implantation. The consequent formation of the once dreaded "wet" colostomy with combined urinary and fecal discharge presents some difficulties in management not occasioned by the usual "dry" colostomy.

Appleby[6] has attempted bilateral ureterocecal transplants, claiming thereby to reduce the wet colostomy efflux by 30 per cent. He reports survival in four cases from four and a half to seven years. Experimental evidence does not substantiate the feasibility of this procedure. Boyce[7] has shown in the experimental animal (dog) that longevity is greatly reduced following diversion of the entire urinary stream into the cecum. In these animals the absorption of nitrogenous constituents from the colon resulting in elevation of blood non-protein nitrogen, urea nitrogen and creatinine caused a uremic type death in sixteen to twenty-one days.

It is our purpose to present a brief summary of experience with approximately thirty-five ureterosigmoidostomies and to suggest the use of a new tube to facilitate the immediate postoperative care of these patients.

Although we have customarily opened the colostomy at the completion of the operation even though it is implanted in the main wound, we have never seen complications directly attributable to this procedure. With the use of the mucosa-to-mucosa type of ureterosigmoid anastomosis minimizing stomal edema, urine may appear almost immediately on the dressing.

During the first two or three postoperative days the usual wound dressings augmented with thick abdominal pads of gauze are most helpful in absorbing urinary drainage. The adjunctive use of various protective skin pastes such as aluminum oxide, castor oil–zinc oxide mixture, Bellinger's paste or simply vaseline gauze around the wet colostomy are valuable in preventing skin breakdown and keeping excretory products from constantly bathing the underlying healing wound.

Since the wet colostomies are located in or near the long abdominal wound, the presence of dressings saturated with urine may theoretically slow wound healing, predisposing to wound infection and skin maceration. Perhaps the major factor in failing to collect the urine in a receptacle is the inability to judge output volume in estimating fluid balance. Although dressings may be weighed, this is not a practical method for the average hospital.

In lieu of wound dressings a useful alternative is to tie a large bulbous retention catheter into the projecting bowel at the completion of the operation. This obviates the pocketing of any large amount of urine in the distal colon segment with subsequent discomfort to the patient. Further, with the bowel atonia following operation there may be some delay in the appearance of liquid contents at the colostomy stoma. Water (urine) always running downhill or taking the path of least resistance may gravitate into the proximal descending colon in the absence of peristaltic activity. Since the ureters are usually implanted on an ascending near vertical limb of sigmoid colon both gravity and the variable edema of the colostomy stoma must be overcome. These factors are evident in patients with preliminary transverse colostomies in whom the urine may drain almost entirely from the distal stoma of the transverse colon and very little from the lower sigmoid colostomy.

By far the most satisfactory method of collection in handling a wet colostomy is the use of a water seal type of bag. Several practical

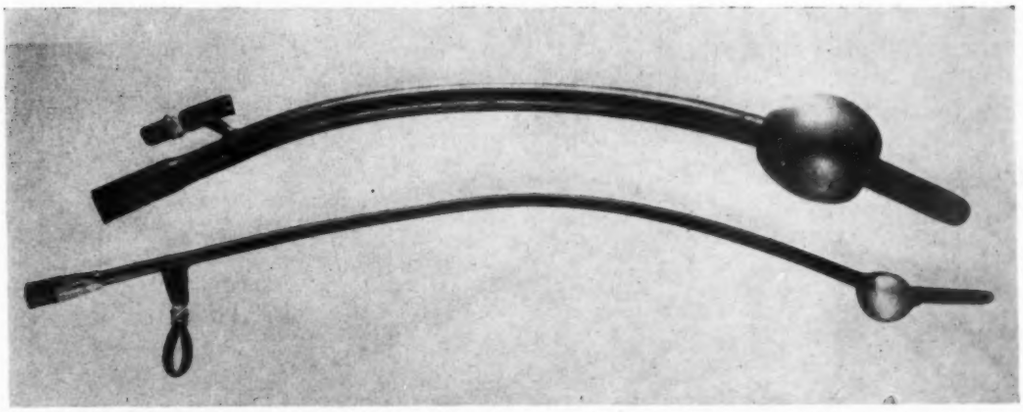

FIG. 1. Giant 40F tube (upper) with bag inflated compared to standard 20F Foley catheter (lower).

models are now available. (Rutzen, Carhart, Fazio, Pierce, Hays, Perry.) These bags are ideal for the convalescent care of these patients, in general almost solving the problem of wet colostomy management. However, it is apparent that the use of these bags is not feasible during the first seven to ten postoperative days, with the exception of the Bellinger cup which may be used immediately. A period of at least ten days is necessary for the colostomy stoma to shrink down and assume a semblance of its future shape.

Many of the colostomy rings in the rubber or plastic bags must be cut or measured to fit the stoma. If a water-tight seal is to be maintained, it is apparent that maximum shrinkage should have occurred. In addition, fitting a bag too early may necessitate the repurchase of a smaller or larger assembly after the stoma has assumed its final shape.

Besides this requirement other disadvantages of a bag in the immediate postoperative period may be mentioned. The presence of even slight skin maceration with an exudative, weeping surface about the colostomy may prevent adherence of the skin cement necessary for the bag's water-tight seal. As the healing wound may be quite tender, many patients are unable to tolerate the pressure of a bag prior to the second postoperative week.

The difficulties of controlling a wet colostomy with the attendant frequent dressing changes until bag usage became practical led to a trial of intubating the stoma immediately or after two or three postoperative days. A soft rubber catheter of the rectal tube variety was used with varying success. This tube was difficult to maintain in spite of diligent attempts at security. Further, the diameter of the tube was usually not adequate to conduct soft fecal material without frequent plugging.

With the cooperation of C. R. Bard, Inc., Summit, New Jersey, one of us (J. W. B.) designed a large, soft rubber tube with an inflatable end balloon. (Fig. 1.) The lumen of this tube is 40F with a 30 cc. bag located 1½ inches from a whistle tip. This is, of course, a Foley type bag so commonly used for constant bladder drainage. However, most hospitals do not stock larger than a 28 to 30F Foley catheter. The larger diameter of this special tube facilitates the passage of thin fecal material frequently seen in the early postoperative period. This tube is easily retained by inserting the bag below the level of the rectus muscle and fascia and inflating it with 5 to 10 cc. of water. (Fig. 2.) Usually this degree of inflation is sufficient to hold the tube against the forces of gravity and peristalsis. Inflating to the maximum capacity of the balloon is unnecessary and causes the patient local discomfort. This tube may be placed on suction but gravity drainage is frequently satisfactory.

The theoretic danger of pressure necrosis from an inlying tube is largely obviated by the presence of the balloon which when even partially inflated tends to maintain the tip of the catheter in the center of the bowel lumen. We have not seen any damage to the bowel wall from the use of these tubes. Examination of the distal colon segment at necropsy in patients expiring during the first two postoperative weeks failed to reveal any damage resulting from the presence of the tube.

It should be emphasized that this tube is not advised as a permanent collecting apparatus. The tube is intended to function as a convenient means of collecting excreta until

the wearing of a bag becomes possible. In addition, early use of tube drainage of the wet colostomy minimizes the transient rise in blood urea nitrogen so frequently seen in the first postoperative week.

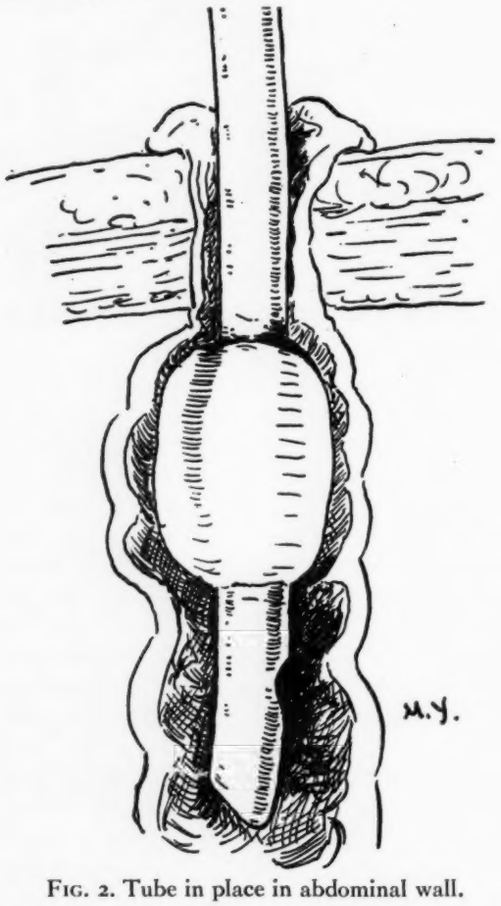

FIG. 2. Tube in place in abdominal wall.

Patients have reported that with the assumption of the recumbent posture, particularly at night, the water seal bags occasionally leak. Several women who have removed the bag at night and inserted this tube (connected with a bedside jar) have had no soiling during the night. Also, it has been found convenient to use the tube for a morning cleansing enema before attaching the bag. Boyce states that rectal or colostomy drainage during sleep may be necessary or desirable far beyond the usual period of hospitalization.

It may be stated that we advise these patients to use irrigations whenever necessary. Liquid stools are not invariably present. In time the colostomy may in addition to a rather constant dribble of urine discharge one to two semi-formed stools per day. These patients have been known to become constipated since the conditions proximal to the implanted ureters are essentially the same that prevail with a dry colostomy. We have not seen any so-called reflux ureteritis or pyelonephritis from the occasional use of colostomy irrigations, providing there was no frank obstruction at the ureterosigmoid anastomoses.

This large diameter bag catheter has also been used in the rectal segment to facilitate the care of patients following total cystectomy. Periods of diarrhea or fecal incontinence are not infrequent and again nursing care is simplified and the patient's comfort furthered by the judicious use of this tube.

SUMMARY

Several problems in the management of ureterosigmoidostomy following radical pelvic surgery are discussed. The use of a large diameter rubber catheter with inflatable cuff is suggested to facilitate the collection of combined urinary-fecal discharge in the immediate postoperative period preparatory to the application of a water seal bag.

Many urologists believe and experimental evidence suggests that following ureterosigmoid anastomosis careful attention to constant rectal or colostomy drainage is important during early convalescence.

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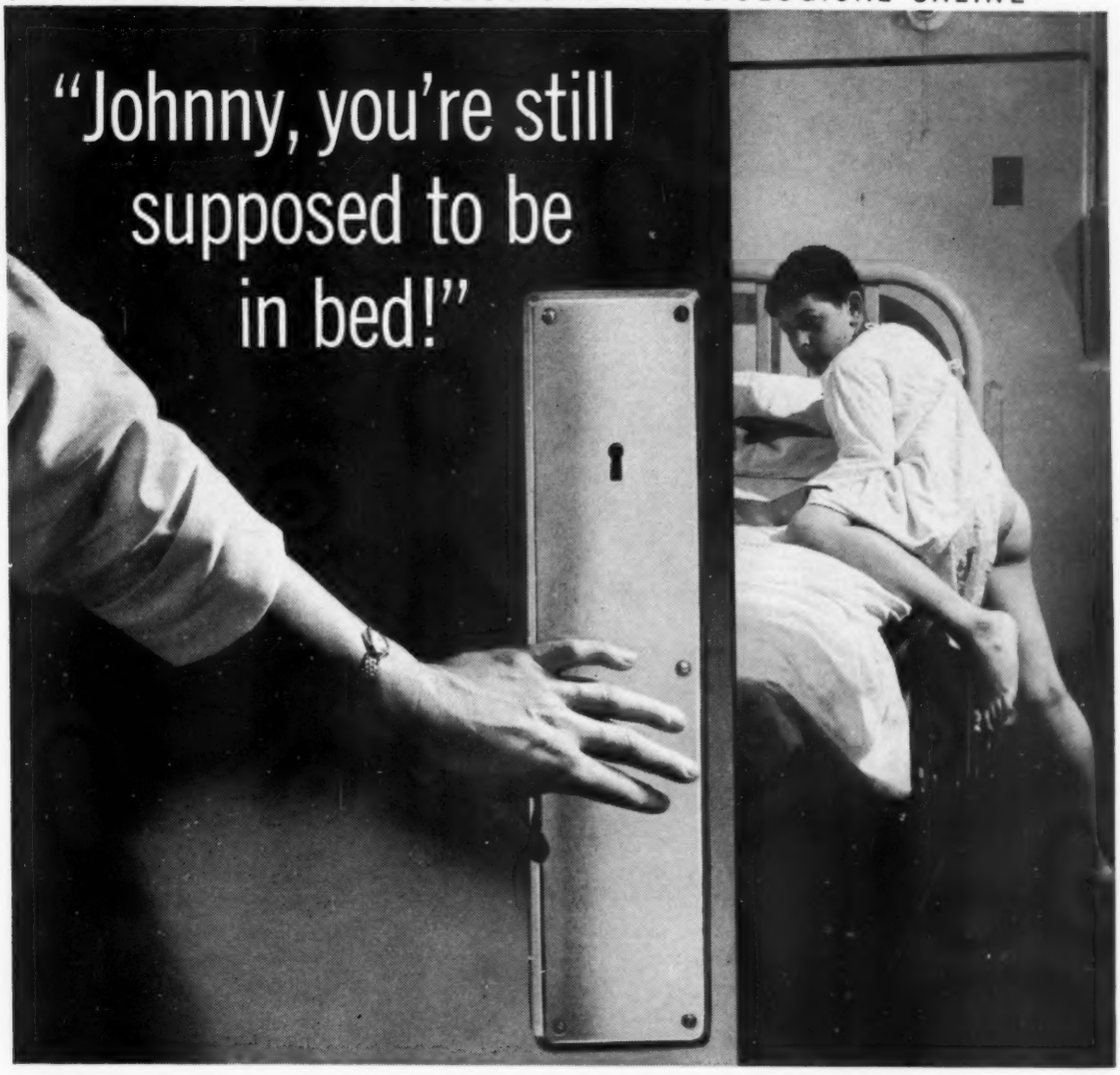

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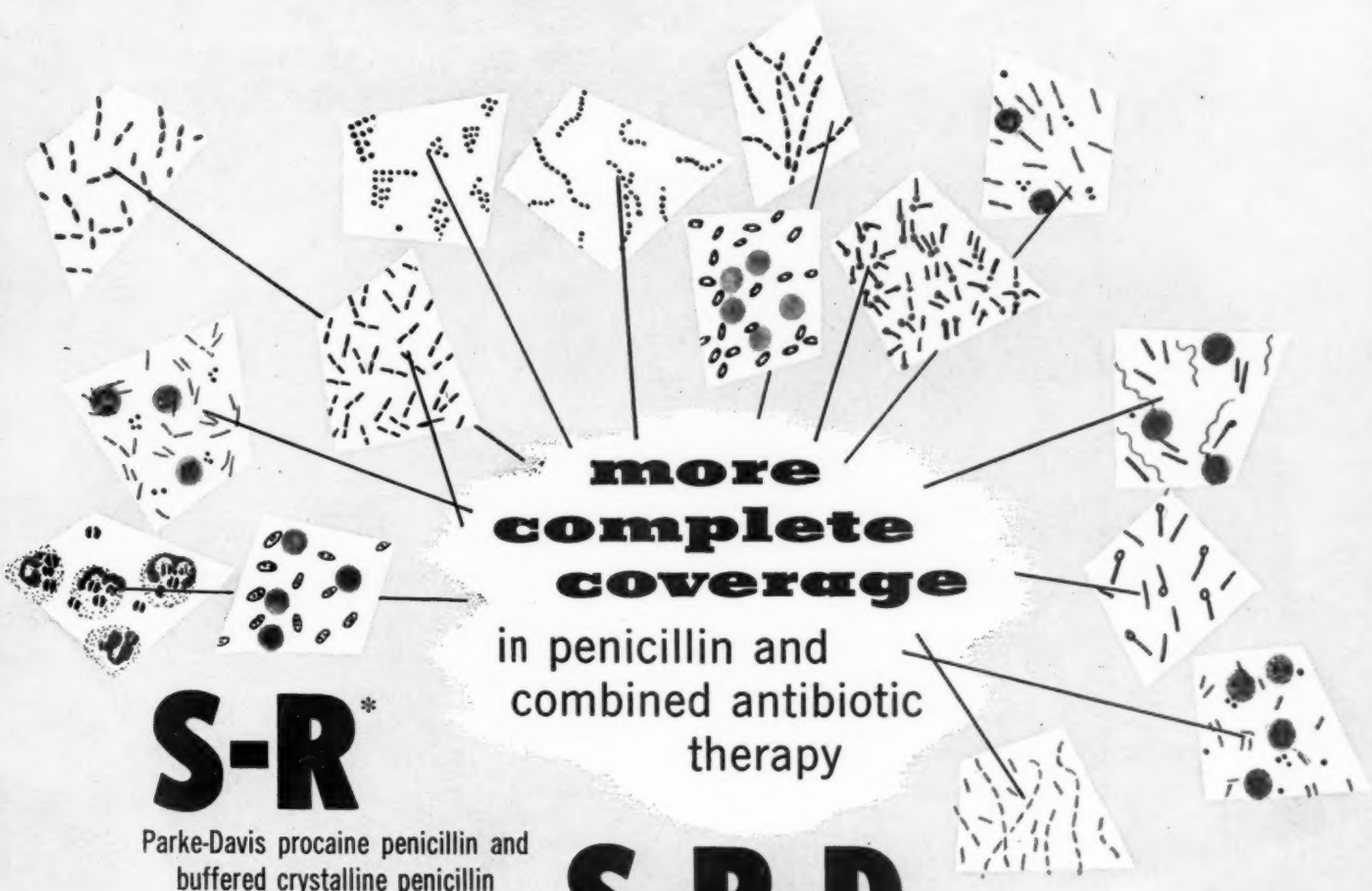

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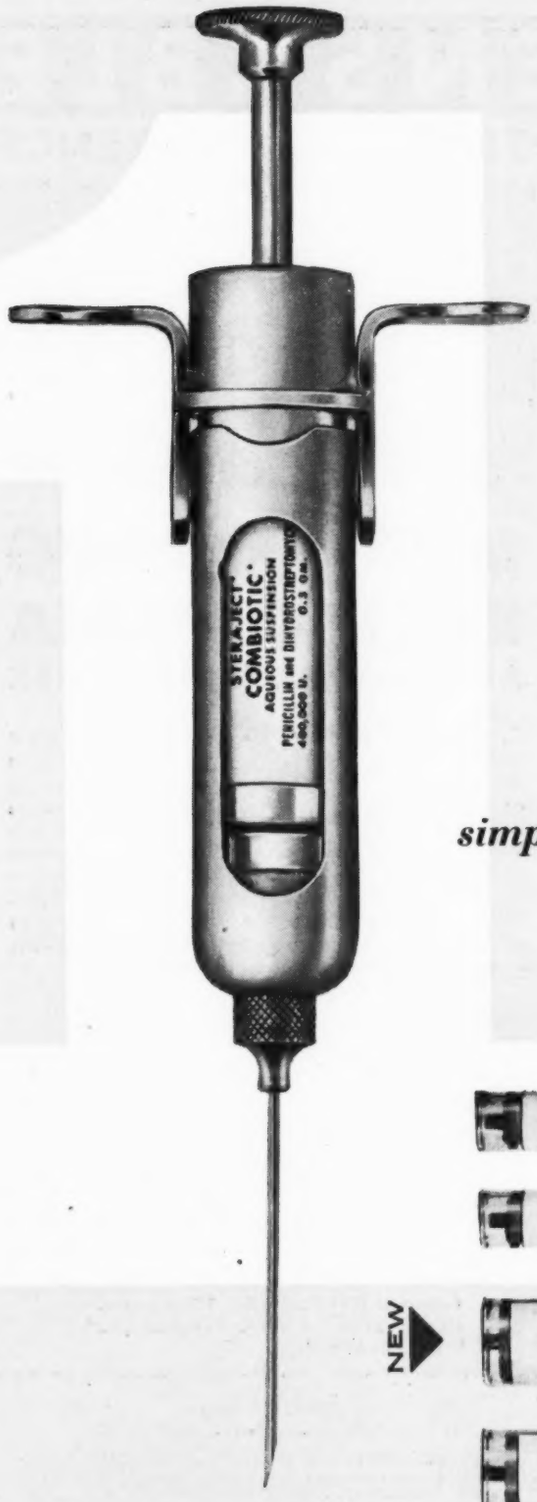

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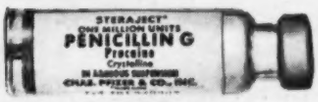

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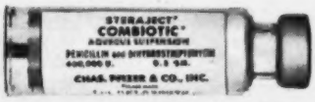

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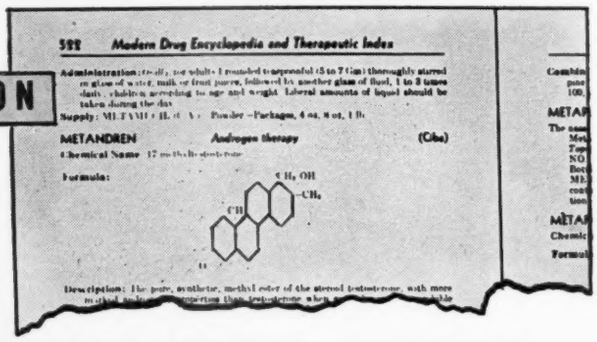

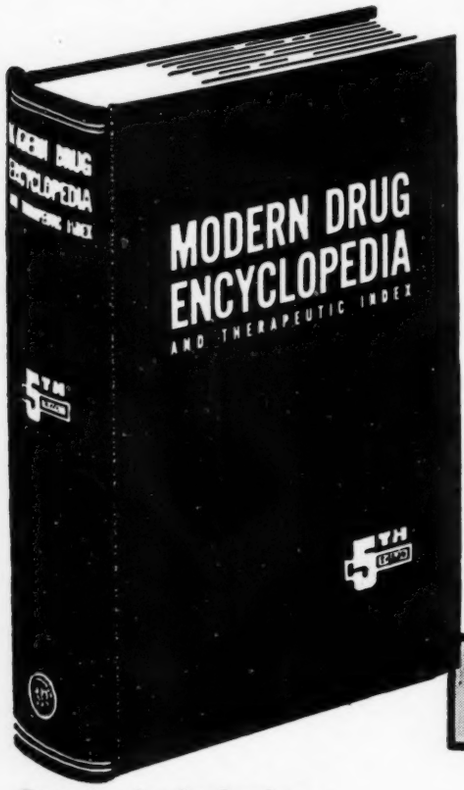

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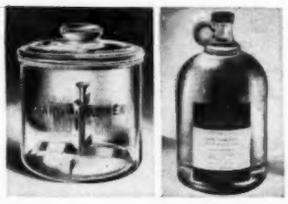

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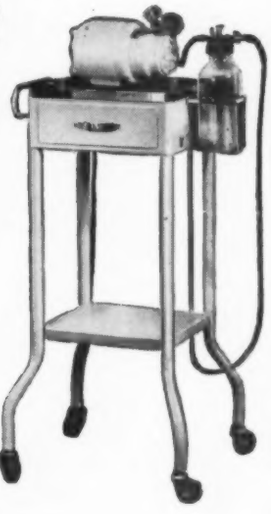

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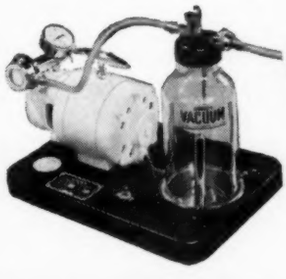

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Outside the Ivory Tower

CONSERVATION of life among infants during the dangerous first month following birth provides the best opportunity for reducing the toll of preventable death in early life, according to Metropolitan Life Insurance Company statisticians. Each year about 78,000 babies in the United States fail to survive the first month of life, which is more than twice as many as succumb during the next eleven months, the statisticians report. Premature births cause about half of the loss of life in the first month and the majority of the other deaths are due to injury at birth or congenital malformation. The chances of survival for a prematurely born baby are directly related to its degree of maturity as measured by birth weight. Of the babies who weigh up to 2 pounds 3 ounces at birth, 95 per cent die in the first month, compared with a death toll of less than 1 per cent for babies over 5½ pounds.

THE Society for the Prevention of Asphyxial Death, Inc., announces the beginning of its sixth year of sponsorship of courses in resuscitation. Instruction stresses the elimination of the death zone of the respiratory tract through lectures, demonstrations and clinical practice in laryngoscopy and intubation of dogs and cadaver. While the course is given regularly in New York City, on the first Friday and Saturday of each month, out of town classes have met in Boston, Massachusetts; Columbus, Ohio; Washington, D. C.; Los Angeles, California and in Honolulu. Requests for out of town courses will be considered when application is made by a group of at least twelve students. For information please write, Secretary, S.P.A.D., 2 East 63 Street, New York City 21, New York.

HOW lucky are you? One good way to find out is by studying the 1951 story of traffic accidents in the United States just published by The Travelers Insurance Companies of Hartford, Conn. This latest edition of their annual series is called, appropriately enough, "Lucky You." They make the point with facts and figures that if you were not involved in a serious auto accident last year, you are indeed lucky.

If you are a speeder, for example, the 1951 record will show you how lucky you are to be alive and well. Nearly 14,000 persons were killed and more than half a million were injured last year by drivers who were exceeding the speed limit. One of every three drivers involved in 1951's serious accidents was speeding. Last year, as in 1950 and previous years, excessive speed was far and away the most dangerous mistake in driving.

GOVERNMENT and industry were urged to discard the economically wasteful and socially harmful policy of compulsory employee retirement at age sixty-five, and to begin planning now a constructive program to deal with the growing problem of older workers. The recommendation was made by a group of seventy-five experts in industrial relations, medicine, labor and education at the close of a three-day conference on the nation's aging population. Dr. Theodore G. Klumpp, president of Winthrop-Stearns, Inc., was chairman of the conference. Sponsors were the McGregor Fund of Detroit and the National Committee on the Aging of the National Social Welfare Association. The conferees agreed that retirement solely on the basis of age was socially wasteful, and that "older persons willing and able to meet job requirements could make a positive contribution to the national economy." The country is now losing the potential labor of 1,500,000 persons who could earn $4,500,000,000 a year, according to Dr. Thomas Parran, dean of the Graduate School of Public Health at the University of Pittsburgh.

PRISCOLINE (Ciba), a vasodilating agent which was recently (*J. A. M. A.*, 148: 1083, 1952) observed to relieve muscle spasms in certain polio patients, may also serve to reduce the need for amputation in cases of gangrene and ulceration caused by poor circulation in the extremities, according to a clinical investigation reported in the April issue of Angiology, the Journal of Vascular Diseases.

The investigation, using Priscoline, was conducted by Dr. Heinz I. Lippmann at Montefiore Hospital, New York City, over a period of three years. Eighty cases of peripheral vascular diseases, including patients with arteriosclerosis, cardiac conditions and diabetes were studied. Dr. Lippmann reported that of a group of twenty-two patients with gangrene of the heel eleven were treated with Priscoline while the remaining eleven received conven-

(continued on page 48)

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Outside the Ivory Tower

(*continued from page 46*)

tional therapy. Of the eleven treated with Priscoline eight recovered without amputation. In the group of eleven who did not receive Priscoline only two recovered without amputation. Commenting upon the results, Dr. Lippmann reported, "the healing of ischemic heel lesions after prolonged intermittent intra-arterial Priscoline treatment, in addition to proper management, constitutes the most tangible achievement of this form of therapy to date."

MORTALITY from alcoholism in the industrial population has declined by 85 per cent over the past forty years, the Metropolitan Life Insurance Company statisticians report. Deaths from acute and chronic alcoholism averaged 6.3 per 100,000 of the company's industrial policyholders in the period 1911 to 1917, and 0.9 per 100,000 in 1950. The alcoholism death rate in the insured group fell sharply in the years just prior to the Prohibition Amendment, reached its lowest point of 0.7 per 100,000 in 1920, the first year the Amendment was in effect, and then moved upward to a second but lower peak of 4.9 per 100,000 in 1926. From that point through the years a downward trend of the death rate has been maintained.

AMERICANS are still predominately a small town and rural people despite the rapid growth in city population, statisticians of the Metropolitan Life Insurance Company pointed out from a study of population trends as shown by the 1950 census.

Three-fifths of the American people live in places with fewer than 25,000 residents, the statisticians said. Less than one-quarter of the people live in cities with populations as large as 250,000. In fact, twenty-five states have no cities as large as 250,000 and thirteen have no cities above 100,000. In general, the South has the largest proportion of people living in small towns and rural areas, while the Northeast has the lowest percentage in such places. In only seven states—Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Illinois, and California—do the majority of people live in cities larger than 25,000. On the other hand, in states such as Mississippi, South Carolina and North Dakota the percentage of rural population runs as high as 70 per cent. New York is the most urbanized state, with 59 per cent of its residents in cities of 250,000 or over.

ACCORDING to an announcement by Dr. E. R. Weidlein, President, Mellon Institute, Pittsburgh, Pa., the Multiple Fellowship on Orthopedic Appliances, sustained there by special grants from the Sarah Mellon Scaife Foundation, will begin its sixth year of activities on a materially broadened research and development program. During the five years in which the Fellowship has been working thus far, major attention has been directed at the many special design and fabrication problems involved primarily in leg, arm and back braces. Only in the past year has much study been accorded to other kinds of mechanical aids for crippled and handicapped persons, and to improvements in the instrument armamentarium of the orthopedic surgeon.

In order to guide effectively the Fellowship's investigational and developmental projects, which are quite unlike those of the average research group, a special Medical Advisory Committee, under the chairmanship of Dr. Weidlein, has been set up. Serving on it at present are Dr. William S. McEllroy, Dean, School of Medicine, University of Pittsburgh, Dr. Paul B. Steele, Professor and Head of the University's Department of Orthopedic Surgery, and Dr. John A. Heberling, Associate Professor of Orthopedic Surgery. Dr. Carl C. Yount, internationally known authority on orthopedics, and an Associate Professor of Orthopedic Surgery in the University and another member of the Committee, has accepted appointment as an Advisory Fellow of the Institute, to work closely with the staff of the Orthopedic Appliances Fellowship. Finally, Dr. Donald A. Covalt, of New York, N. Y., and Dr. Augustus Thorndike, of Boston, Mass., have consented to serve on the Advisory Committee. Dr. Covalt is Associate Professor, Department of Physical Medicine and Rehabilitation, New York University College of Medicine, and Associate Director of the New York University-Bellevue Institute for Physical Medicine and Rehabilitation. Dr. Thorndike is a surgical consultant to the Department of Medicine and Surgery of the Veterans Administration, and Acting Director of the Prosthetic and Sensory Aids Service, V. A.

(*continued on page 50*)

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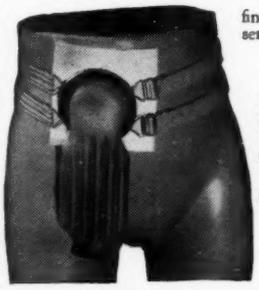

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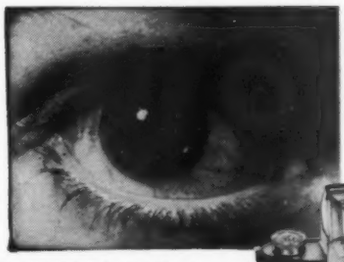

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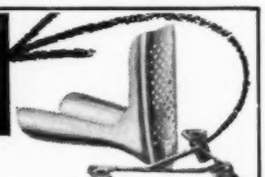

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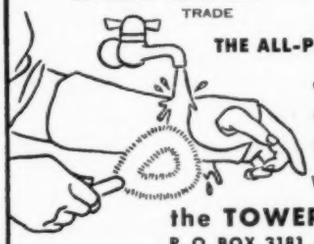

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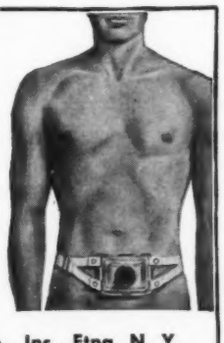

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Outside the Ivory Tower

(continued from page 48)

CHESEBROUGH Manufacturing Company, makers of 'Vaseline' brand products, celebrated its fifteenth birthday as sponsor of the perennially popular Dr. Christian show, with a party (May 21) in the Hunt Room at "21" Club. The party also honored Dorothy B. McCann, sponsor of the show for McCann-Erickson, Inc., and stars, Jean Hersholt and Rosemary De Camp, who play Dr. Christian and Nurse Judy Price, respectively. All have been associated with the program since its inception fifteen years ago.

Guests who congregated to eat birthday cake, dance and congratulate the program participants included Chesebrough and McCann-Erickson executives as well as many celebrities from the entertainment field—Sonja Heinie, Don Ameche, Martha Raye, Jane Pickens, Dana Andrews and Bert Lytell.

CONSTRUCTION has started on a new, four-story office building at Lederle Laboratories, Pearl River, N. Y. The new building, which will be 80 feet deep and 300 feet long, will provide working space for about 700 administrative personnel. It will be of reinforced concrete frame construction, and will be completely air conditioned. Dr. B. W. Carey, Director of Laboratories, said that the new building will house executive offices and a number of administrative, sales and service departments. Several sales offices in 30 Rockefeller Plaza, New York City, will also move to the new building at Pearl River.

TO anyone interested in a history of Civil War medicos, the methods of transporting the wounded, the surgery done at the time and the treating of the medically ill, as well as the hospitals of that day, we recommend "Doctors in Blue" by George Worthington Adams, published by Henry Schuman, Inc., New York.

We learn that in the American Civil War 300,000 Union soldiers lost their lives. There were more than 400,000 cases of wounds and 6,000,000 cases of sickness. From a surgical viewpoint most of the wounds were in the extremities. If radical amputation was necessary, infection was the usual result. The mortality rate was high. A wound in the chest or abdomen was nearly always fatal. But after the mistakes caused by poorly trained rural physicians, poor anesthesia, a lack of knowledge concerning bacteria (Lister came later) and the causes of sepsis, a poor or no ambulance service, came a semblance of order and, according to the author considering everything, "the medical and sanitary record of the Civil War was on the whole a good one." It is a gruesome recital; but to those of our calling who served in the last war it will be strikingly impressive because of the great distance we have come. Historically, it is a valuable and needed work. Written by a careful historian, it will serve as a permanent contribution on this subject. $4.00.

THE Blakiston Company brought out "Psychosurgical Problems," edited by Fred A. Mettler, M.D., PH.D., for the Columbia Greystone Associates, Second Group of 36 Investigators. ($7.) The book is 357 pages long, and contains 56 figures, 4 plates and 57 tables. A bibliography and an index are included. It is a factual report on the basic problems of psychosurgery and a summary of actual case histories. It should be valuable to all psychiatrists, neurologists and surgeons and is highly recommended. $7.00.

For an hour's reading before bedtime we suggest When Doctors Are Patients, Edited by Max Pinner, M.D. and Benjamin Miller, M.D. When we first scanned the pages, our subconscious thought was "another of those things"; but once we started reading, we were loath to put the book down. Thirty-three physicians contribute to the volume with clinical descriptions of their own diseases, some fatal, others merely disabling. Those who have been or are narcotic addicts, alcoholics or who suffer mental disorders write under pseudonyms. All in all fascinating, this book contains 364 pages. W. W. Norton & Co., Inc. $3.95.

Also recommended is Doctors in Blue by George Worthington Adams, which is a classic. Dr. Adams has given us a survey of the medical history of the Union Army in the Civil War. Comparing disease and injury as handled nearly a century ago with that of World War II, one is impressed with the gigantic advances made in every field of medicine, surgery and public health. Henry Schuman, Inc. $4.00.

SCIENTIFIC trick of the month (From the N. Y. Herald Tribune): "A doctor froze Jos. V. Cas, Jr.'s appendix with aureomycin today so he could get married."

(continued on page 52)

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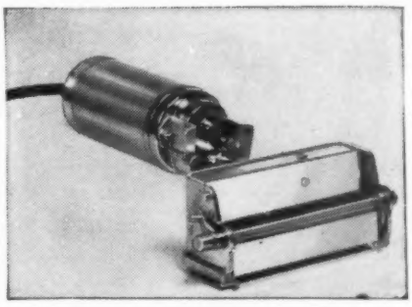

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Outside the Ivory Tower

(*continued from page 50*)

A STUDY to determine if isonicotinic acid hydrazide (Pyricidin-Nepera Chemical Co.), one of the new antituberculosis drugs, has a place in public health efforts to control tuberculosis is being made by the New York City Department of Health. Announcement that the study was underway was made on May 21, 1952, by Dr. John F. Mahoney, Commissioner of Health. A six-man committee of outstanding tuberculosis specialists has been named by Dr. Mahoney to review the data produced in the study and to advise the Department of Health in forming a general policy as to the use of the new tuberculosis therapy in control work if the study shows such work should be carried on.

KAHN Surgical Dissecting Scissors, featuring blades with a new wedge shape in the plane of the shanks to give greater utility in every phase of tissue dissection, have been announced by Clay-Adams Co., Inc.

These new scissors have (1) thinner tips for improved visibility when cutting where space is limited; (2) keen cutting edges; (3) rounded tips for probing; (4) side taper and bevel to seek out lines of cleavage in the separation of planes of tissues. Kahn surgical dissecting scissors are lightweight, well balanced and sturdily constructed for continuous use. They are particularly effective in the following procedures: (1) to split fascia, in laparotomy, by an easy pushing action with the blades opened slightly and held in a fixed position. The blades move along, cutting the fascial sheaths sharply, leaving edges that are free of scissors' crush; (2) to probe, tunnel between, separate and cut planes of tissue such as peritoneum and mucosa; (3) to dissect around large blood vessels, the ureters, ducts, nerves, lymph nodes, etc.; (4) to dissect bluntly with the scissors closed and (5) to cut between closely applied clamps to divide ligaments, mesenteries, pedicles, etc., as a substitute for a scalpel. The thin, wedge-shaped blades operate effectively where space is limited.

THE Navy announced that it would make 176 Naval Hospital Internships available to medical school students who will graduate in 1953. All applicants, the Navy said. would be received and processed in accordance with the plan for internship appointments of the National Interassociation Committee on Internships.

Prospective Navy interns must meet all requirements for a commission in the Medical Corps, U. S. Naval Reserve, and must serve a minimum of twenty-four months of active duty, commencing on the date they start the intern training. Appointees to the Naval Internships will be commissioned Lieutenants (junior grade) in the Medical Corps of the Naval Reserve and will receive the pay and allowances of that rank during their internship.

The Navy's Bureau of Medicine and Surgery said its internship training has the approval of the American Hospital Association, the Association of American Medical Colleges, the American Protestant Hospital Association, the Catholic Hospital Association and the Council on Medical Education and Hospitals of the American Medical Association.

Students interested in a Navy internship may obtain further information at any Office of Naval Officer Procurement, or by writing to the Surgeon General of the Navy, Bureau of Medicine and Surgery, Navy Department, Washington 25, D. C.

WE read in the June, 1952 issue of the New York State Journal of Medicine, of the retirement of Dr. George W. Kosmak as Editor. A splendid gentleman; the State Journal loses an outstanding editor. For many, many years Dr. Kosmak has been the editor of The American Journal of Obstetrics and Gynecology. Shortly after he became editor we had a paper published in his journal. In this editorship he has been outstanding. We hope Dr. Kosmak has no intention of retiring from The American Journal of Obstetrics and Gynecology, but will continue on until the last day. Only best wishes.

AT the recent A.M.A. convention in Chicago, we noted in the Program of the Scientific Assembly the sequence of the following two papers: (1) Vaginal Hysterectomy for Uterine Prolapse: Report of 1,000 Cases; the title of the next paper (2), Is This Hysterectomy Necessary?

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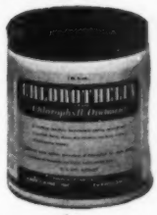

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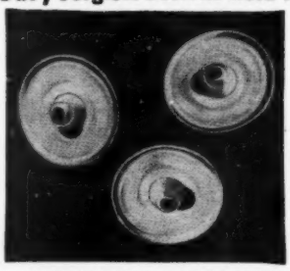

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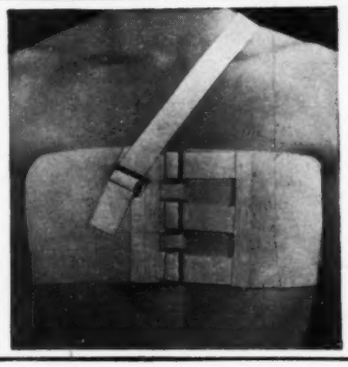

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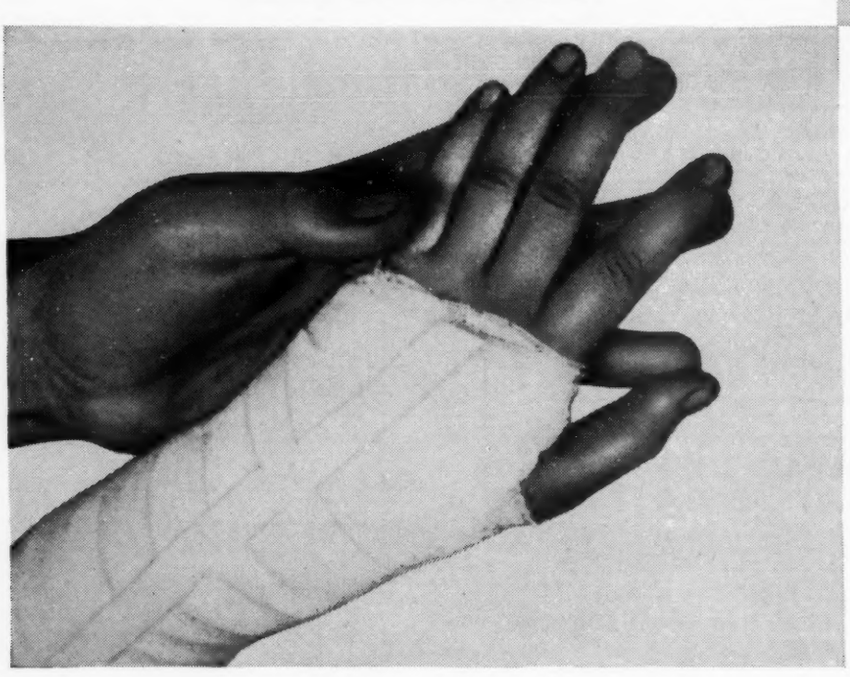

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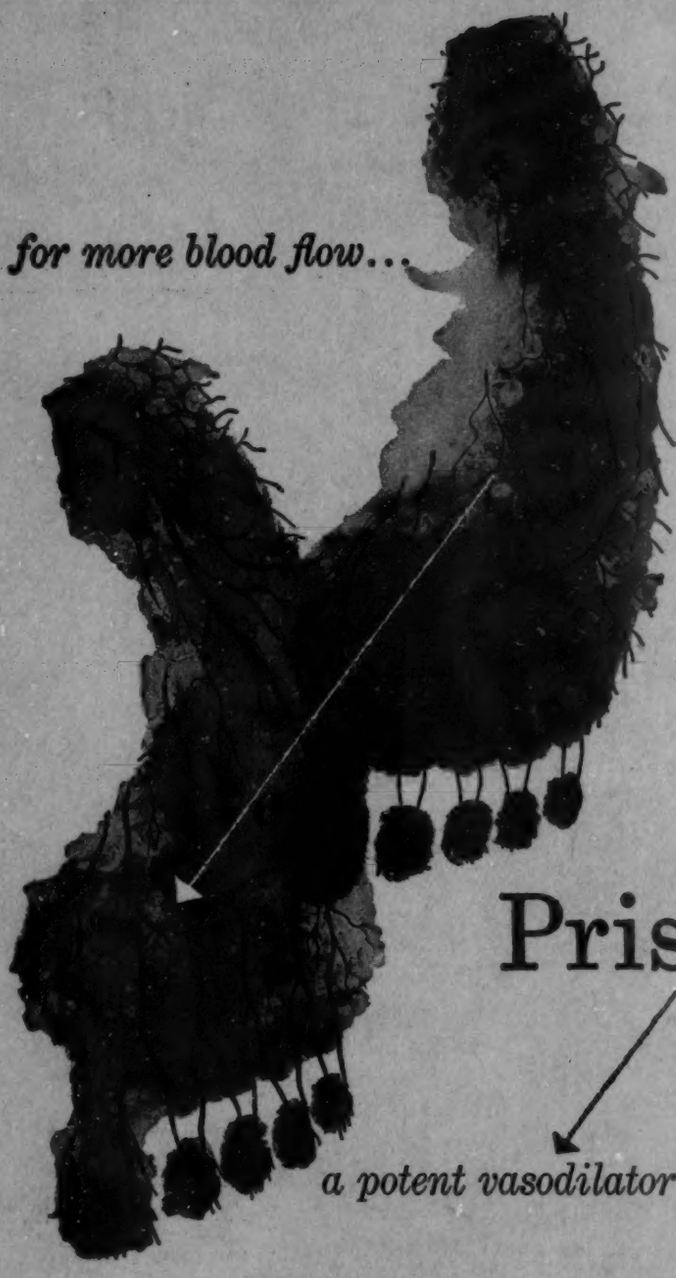

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